CHAPTER 3
Specifications, Tolerances, and Other Technical Requirements for Testing and Certifying Official Grain Weighing Devices

3.1 GENERAL

a. Purpose

The purpose of this chapter is to establish procedures for ensuring the accuracy of scales and weighing systems used to officially weigh and inspect grain and to provide uniformity in the inspection and testing of weighing devices used for that purpose.

b. Authority

Section 7B (a) of the United States Grain Standards Act (Act), as amended, states: "The Secretary shall provide for the testing of all equipment used in the sampling, grading, inspection, and weighing for the purpose of official inspection, official weighing, or supervision of weighing of grain located at all grain elevators, warehouses, or other storage or handling facilities at which official inspection or weighing services are provided under this Act, to be made on a random and periodic basis, but at least annually and under such regulations as the Secretary may prescribe as he deems necessary to assure the accuracy and integrity of such equipment."

(1) Section 7B (b) states: "The Secretary is authorized to cause such testing provided for in subsection (a) to be performed (1) by personnel employed by the Service, or (2) by States, political subdivisions thereof, or persons under the supervision of the Secretary, under such regulations as the Secretary may prescribe."

(2) Section 7B (c) states: "Notwithstanding any other provision of law, no person shall use for the purposes of this Act any such equipment not approved by the Secretary."

c. Fundamental Considerations

(1) General Observations on Accurate Weighing Enforcement

(a) In accordance with the Act, the Federal Grain Inspection Service (FGIS), of the Grain Inspection, Packers and Stockyards Administration has established a nationwide weighing program. This program includes the certification of grain weight and the

(b) testing and certification of the scales and weighing systems used for official grain weighing and inspection. FGIS, delegated, and designated States must test all grain scales at facilities which request official weight certification.

(c) All procedures outlined in this section of the Handbook shall be performed in accordance with the applicable Occupational Safety and Health Administration (OSHA), Department of Agriculture, and FGIS safety standards.

(2) Acceptance or Rejection of Official Weighing Equipment

Acceptance or rejection of official weighing equipment shall be based on the ability of this equipment to meet the specifications, tolerances, and performance requirements outlined in this chapter. These requirements are derived primarily from applicable sections of the General Code, the Scale Codes, the Automatic Bulk Weighing System Code, and the Weights Code of the 1994 edition of National Institute of Standards and Technology (NIST) Handbook 44, "Specifications, Tolerances and Other Technical Requirements for Weighing and Measuring Devices" (Handbook 44); and NIST Handbook 105-1, "Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures" (Handbook 105-1), 1990 Revision.

(3) Request for Approval of New Installation or Modification to an Existing System

All new scale installations and/or modifications to systems must be approved prior to use for official weight certification. Prior to testing a new installation or modification, the local scale official shall send the following information to the FGIS Weighing and Equipment Branch and a copy to the field office manager in charge: (1) facility name, address, and contact; (2) scale type, model, kind, dimensions, capacity, divisions, and manufacturer; (3) number and capacity of load cells; (4) statement of scale usage; (5) number, weight, and type of test weights; (6) description and reason for modification, and proposed dates for modification and initial testing; and (7) prototype evaluation information. (H-44, 1994 UR.4. in part)

(4) Security Seals

All weighing devices shall be provided with sealing access points to adjustable components including junction boxes containing adjustable

components. (Nose-irons and other lever adjustments need not be sealed.) Access points shall be sealed with prenumbered seals. Unauthorized breakage of a seal will require recertification of the scale. Crimpers used to fasten lead wire seals and pre-numbered seals shall be kept in a secure place. Application or removal of a seal shall be recorded on the "Scale Test Report" forms (FGIS-965, FGIS-965-1, FGIS-965-2) and the "Scale Record Log" (FGIS-963) with appropriate explanations.

(5) Prohibited Practices

Coupled-in-motion weighing on railway track scales and weighing on belt conveyor scales is not permitted for official weight certification due to the relative inaccuracy of such devices and methods.

d. Documentation

(1) General

All scale tests performed by FGIS, delegated States, or designated States shall be properly documented on FGIS forms. FGIS shall supply scale testing forms, approved labels for inspected machineries, and scale record logs necessary for official scale testing purposes.

(2) Approved Label for Inspected Machinery (Form FGIS-93l)

An approval label shall be applied on each scale upon completion of an official test, if the scale has been approved for official weight certification. The approval label shall be placed so that it is visible during normal scale operation. The official certifying the scale shall sign and date the approval label in the appropriate space and write the certified capacity on the label. The "Scale Record Log" must be updated to note that the scale was tested and a new label was applied. The approval label shall be removed from scales that are rejected or exceed the specified test schedule by more than 8 weeks.

(3) Rejected Tag (Form WH-11)

A Rejected Tag shall be placed on each weighing system when determination is made that the scale exceeds acceptable limits and cannot

be used for official weight certification. The Rejected Tag should be secured to the scale in such a position that it will be readily apparent that the scale has been rejected for official use. The official personnel rejecting the scale shall sign and date the Rejected Tag in the appropriate spaces. The Rejected Tag number should be recorded on the Scale Record Log and in the appropriate block on the "Scale Test Report." The Approved Label for Inspected Machinery shall be removed from scales that are rejected or taken out of service. A "Repair/Modification Notice," form FGIS-9601, should be issued when repair and/or modification is needed.

(4) Scale Record Log (Form FGIS-963)

The Scale Record Log is an official record which when maintained carefully and accurately will provide important historical data on all scales under the jurisdiction of FGIS. One per scale is required.

(a) Required Information

In addition to descriptive specifications on each scale, the Scale Record Log shall include, but not be limited to, the following information:

1) Scale test dates, times, results, and comments.

2) The next test due date, one of the following; 180, 90, 45, or 30 days, see "e" of this section to determine the next due date.

3) Scale and associated equipment malfunction information and dates.

4) Scale sealing points, seal numbers, and dates. Chapter 2, Section 2.3 details additional information weighers are required to show in the log.

5) Placement and Maintenance

The Scale Record Log shall be placed at or near each scale that is under the jurisdiction of FGIS and maintained by the shift supervisors, weighers, and scale officials. Completed logs shall be kept on file as official documentation.

(5) Scale Test Report

The Scale Test Report shall be used for recording data obtained during an official scale test.

(a) Statistical Data

The top third of the form should be filled out before starting the inspection or testing of the scale.

(b) Test Results

These are recorded during the test and are used to determine compliance with testing instructions and regulations. Results are recorded in the center of the form.

(c) Other Data

Appropriate comments on repairs, adjustments or recommendations, tolerances applied, and necessary signatures are recorded at the bottom of the form. The "as found" condition of the scale shall be noted on the form.

(d) Identification of Forms

The "Scale Test Reports" are identified in the lower left-hand corner and are to be used as follows:

1) FGIS-965 - Scale Test Report -- Grain Hopper (Attachment l).

2) FGIS 965-1 - Scale Test Report -- Railroad Track (Attachment 2).

3) FGIS 965-2 - Scale Test Report -- Vehicle (or portable platform) (Attachment 3).

4) Instructions for Completing Scale Test Reports (Attachment 4).

(e) Distribution of "Scale Test Reports"

The "Scale Test Reports" are marked for distribution in the lower right-hand corner of each copy. They shall be distributed as follows:

1) Original (white) shall be retained in a separate file at the office (FGIS or State) to which the responsibility for the scale is assigned. The hard copy printed record of the test indications shall be attached to the original.

2) First Copy (blue) shall be given or sent to the owner/operator of the scale for their information and records.

3) Second Copy (green) shall be sent to the FGIS, Weighing and Equipment Branch by the FGIS scale specialist responsible for the scale.

4) Third Copy (pink) shall be sent to the FGIS field office which is responsible for the area in which the scale is located.

5) Fourth Copy (yellow) is an extra copy available for an interested party (e.g., State Weights and Measures supervisor or scale service company).

e. Scale Testing Frequency

(1) Semiannual Official Tests

Scale installations under the jurisdiction of FGIS shall be tested twice a year at approximately 6-month intervals. A scale that has been previously tested and found to be in compliance with the instructions regarding accuracy is expected to maintain its accuracy under normal operating conditions from one semiannual test to the next. Whenever possible, scales should be tested "as found" to at least the normal use range. When the scale has been adjusted before testing, the scale shall be considered not maintaining its accuracy and shall be put on an increased frequency testing schedule (see 4 below).

(2) Development of Historical Data

An accurate and thorough history of test results must be maintained so there can be no doubt in justifying why a scale is being rejected and removed from official weighing service due to its inability to maintain accuracy. This historical record should include, but not be limited to, "Scale Test Reports," "Repair/Modification Notices," and "Scale Record Logs," indicating dates, times, and nature of problem occurrences.

(3) First Official Test on Existing Weighing Devices

An existing weighing device receiving its first official test may be allowed for official use even though it does not comply with all FGIS requirements provided the accuracy specifications of this chapter are met. The owner or operator shall be notified in writing that noncompliance items shall be corrected prior to the next official test. Equipment placed in official service for the first time is to be tested again within 30 days.

(4) Increased Frequency Testing

It is important that every scale is tested uniformly, correctly, and without bias. A scale that is found incapable of maintaining its accuracy from one semiannual test to the next should be tested on an increased frequency. The following information is a guideline for increased frequency testing. Time intervals may vary according to circumstances. However, in no case shall a scale that is found to be continually incapable of maintaining its accuracy from one official test to the next be allowed to stay in official service.

(a) When a semiannual test is performed and the test results are found to exceed the allowable tolerance, the scale shall be removed from official service until corrective action is taken to bring the scale within allowable tolerance and as close to zero error as practicable. Notify the scale owner or operator in writing that the scale must be tested again in 90 days. (Notification can be made on the Scale Test Report which is provided to the scale owner or operator.) Problems such as binds, which can cause scales to test out of tolerance, do not necessarily warrant increased frequency testing. If the results of the 90-day test are found acceptable, the owner or

operator shall be notified in writing that the scale is to be tested again in 6 months.

(b) If a 90-day test is performed and the results exceed the allowable tolerance, the scale shall be removed from official service until corrective action is taken to bring the scale within allowable tolerance and as close to zero error as practicable. Notify the scale owner or operator in writing that the scale must be tested again in 45 days. If the results of the 45-day test are found acceptable, the owner or operator shall be notified in writing that the scale is to be tested again in 90 days.

(c) If a 45-day test is performed on a scale and the results exceed the allowable tolerance, the scale shall be removed from official service. A scale that has failed a 45-day test shall not be retested until the owner or operator notifies the scale testing official that all repairs or modifications have been performed to correct the problem. If a new test of the scale is performed following these repairs or modifications and the results are within allowable tolerances, the scale shall be returned to official service. The owner or operator shall be notified in writing that the scale is to be tested again in 45 days.

f. FGIS Type Evaluation Program

FGIS shall, in conjunction with the National Type Evaluation Program (NTEP), conduct evaluations of automatic bulk weighing systems, railway track scales, and grain inspection scales to determine compliance with FGIS regulations and the applicable NTEP type evaluation examination criteria. Only those scales presently approved; and Class II, III, and III L scales that have been evaluated by FGIS or an NTEP authorized laboratory and approved under the NTEP may be used for official weighing and inspection purposes.

(1) Purpose

The purpose of this program is to establish the policy, delegation of authority, and responsibilities for implementation of the FGIS Scales Type Evaluation Program; prescribe procedures for requesting FGIS type evaluation, conducting a type evaluation examination, issuing a "Report of Test" (ROT) or "Certificate of Conformance" (CC), or issuing a letter of nonconformance (rejection for official use); and establish evaluation criteria with which to determine device conformance.

(2) Responsibilities

(a) FGIS, Weighing and Equipment Branch

1) Develop and maintain a list of automatic bulkweighing systems.

a) Establish type evaluation procedures to maintain NTEP accreditation.

b) Coordinate requests for FGIS and NTEP evaluations.

c) Establish a program to ensure that officially used weighing equipment complies with FGIS regulations and applicable NTEP requirements before and after installation.

(b) Scale Officials

1) Ensure that only FGIS approved equipment is installed for official use.

2) Ensure that approved equipment complies with the performance and procedural requirements of FGIS regulations.

3) Ensure that FGIS approved equipment is properly installed, operated, and maintained according to instructions supplied by the manufacturer and FGIS.

4) Ensure that any modifications to officially used scales and weighing systems, which may affect performance, reliability, or integrity, are approved by the Weighing and Equipment Branch before implementation.

(c) Procedures

1) Request for Obtaining FGIS Type Evaluation

All weighing equipment must be approved by FGIS before being allowed for official use. Requests for FGIS type evaluation shall be in writing and include authorization for reimbursement of testing and administrative processing costs. Written requests and all appropriate technical information (e.g., device description, operation) are to be forwarded to:

USDA, GIPSA, FMD, WEB
Ag Stop 3631
1400 Independence Ave.
Washington, DC 20250-3631

A copy of the written request should also be sent to:

NTEP, NIST, OWM
Physics Building 221, Rm A357
Gaithersburg, MD 20899

(3) Conducting an FGIS Type Evaluation

(a) Under Laboratory Conditions

1) Environmental factors must be minimized during certain evaluation tests. Thus, the testing of electronic scale instrumentation is usually performed under controlled laboratory conditions.

2) A manufacturer, whose device is evaluated by FGIS and found to comply with the applicable requirements, is issued a satisfactory CC under the National Type Evaluation Program administrated by NIST. Copies will be sent to official scale testing personnel, Weighing and Equipment Branch, and NTEP.

3) NTEP will issue the CC upon receipt of a satisfactory FGIS evaluation report and distribute copies to State Weights and Measures offices.

a) When a device has undergone FGIS type evaluation and been found not to be in compliance with all FGIS regulations, a letter of nonconformance shall be issued indicating the reason the device does not comply with specific FGIS requirements.

b) If the manufacturer makes the necessary correction, the device may be resubmitted for evaluation. This evaluation process may be repeated several times until the device complies with all FGIS requirements. A request for FGIS type evaluation may be withdrawn by the manufacturer at any time during the process.

4) Under Field Conditions

An onsite evaluation of the weighing system(s) is to be performed by the scale specialist during official inspection of the scale to ensure compliance with the performance and procedural requirements of the FGIS regulations.

a) The scale specialist shall ensure that equipment is approved and has been issued an NTEP CC. Using the CC and the manufacturer's technical literature, the scale specialist shall determine that the equipment is a replica of that which is described in the CC. Only those features and options evaluated and described therein are permitted.

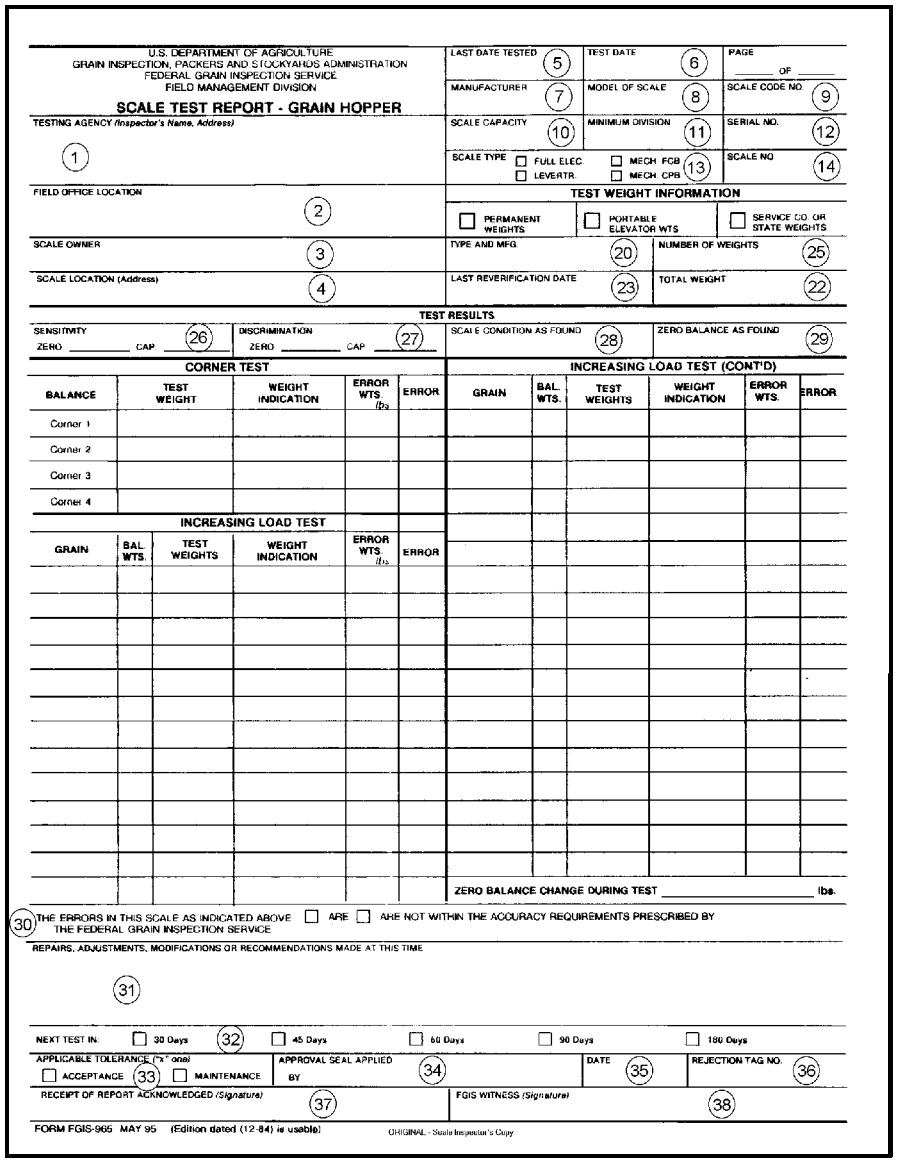
b) The scale specialist shall ensure that the equipment is properly installed, operated, and maintained according to instructions supplied by the manufacturer and FGIS/NTEP. Any modifications

to an officially approved device or system affecting accuracy, reliability, or integrity must be approved by the manufacturer and the FGIS Weighing and Equipment Branch before implementation.

(4) Other Factors

Radio frequency interference (RFI), adverse effects from other grain handling equipment, and environmental influences may adversely affect the performance of a scale. Tests to determine the effects of these factors shall be conducted with equipment and under conditions which are usual and customary with respect to the location and use of the scale. These tests shall be conducted for each new installation or whenever the scale official suspects that performance may be affected by any of the aforementioned factors. (See the Test Procedures Section 3.5 of this chapter for specific procedures).

Scale Test Report -- Grain Hopper



U.S. DEPARTMENT OF AGRICULTURE
GRAIN INSPECTION, PACKERS AND STOCKYARDS ADMINISTRATION
FEDERAL GRAIN INSPECTION SERVICE
FIELD MANAGEMENT DIVISION

SCALE TEST REPORT - GRAIN HOPPER

TESTING AGENCY *(Inspector's Name, Address)* (1)

FIELD OFFICE LOCATION (2)

SCALE OWNER (3)

SCALE LOCATION (Address) (4)

LAST DATE TESTED (5) | TEST DATE (6) | PAGE ____ OF ____

MANUFACTURER (7) | MODEL OF SCALE (8) | SCALE CODE NO. (9)

SCALE CAPACITY (10) | MINIMUM DIVISION (11) | SERIAL NO. (12)

SCALE TYPE ☐ FULL ELEC. ☐ LEVER TR. ☐ MECH. FCB ☐ MECH. CPB (13) | SCALE NO. (14)

TEST WEIGHT INFORMATION

☐ PERMANENT WEIGHTS ☐ PORTABLE ELEVATOR WTS. ☐ SERVICE CO. OR STATE WEIGHTS

TYPE AND MFG. (20) | NUMBER OF WEIGHTS (25)

LAST REVERIFICATION DATE (23) | TOTAL WEIGHT (22)

TEST RESULTS

SENSITIVITY ZERO _____ CAP _____ (26) | DISCRIMINATION ZERO _____ CAP _____ (27) | SCALE CONDITION AS FOUND (28) | ZERO BALANCE AS FOUND (29)

CORNER TEST

BALANCE	TEST WEIGHT	WEIGHT INDICATION	ERROR WTS. lbs	ERROR
Corner 1				
Corner 2				
Corner 3				
Corner 4				

INCREASING LOAD TEST

GRAIN	BAL. WTS.	TEST WEIGHTS	WEIGHT INDICATION	ERROR WTS. lbs	ERROR

INCREASING LOAD TEST (CONT'D)

GRAIN	BAL. WTS.	TEST WEIGHTS	WEIGHT INDICATION	ERROR WTS.	ERROR

ZERO BALANCE CHANGE DURING TEST _____ lbs.

(30) THE ERRORS IN THIS SCALE AS INDICATED ABOVE ☐ ARE ☐ ARE NOT WITHIN THE ACCURACY REQUIREMENTS PRESCRIBED BY THE FEDERAL GRAIN INSPECTION SERVICE

REPAIRS, ADJUSTMENTS, MODIFICATIONS OR RECOMMENDATIONS MADE AT THIS TIME

(31)

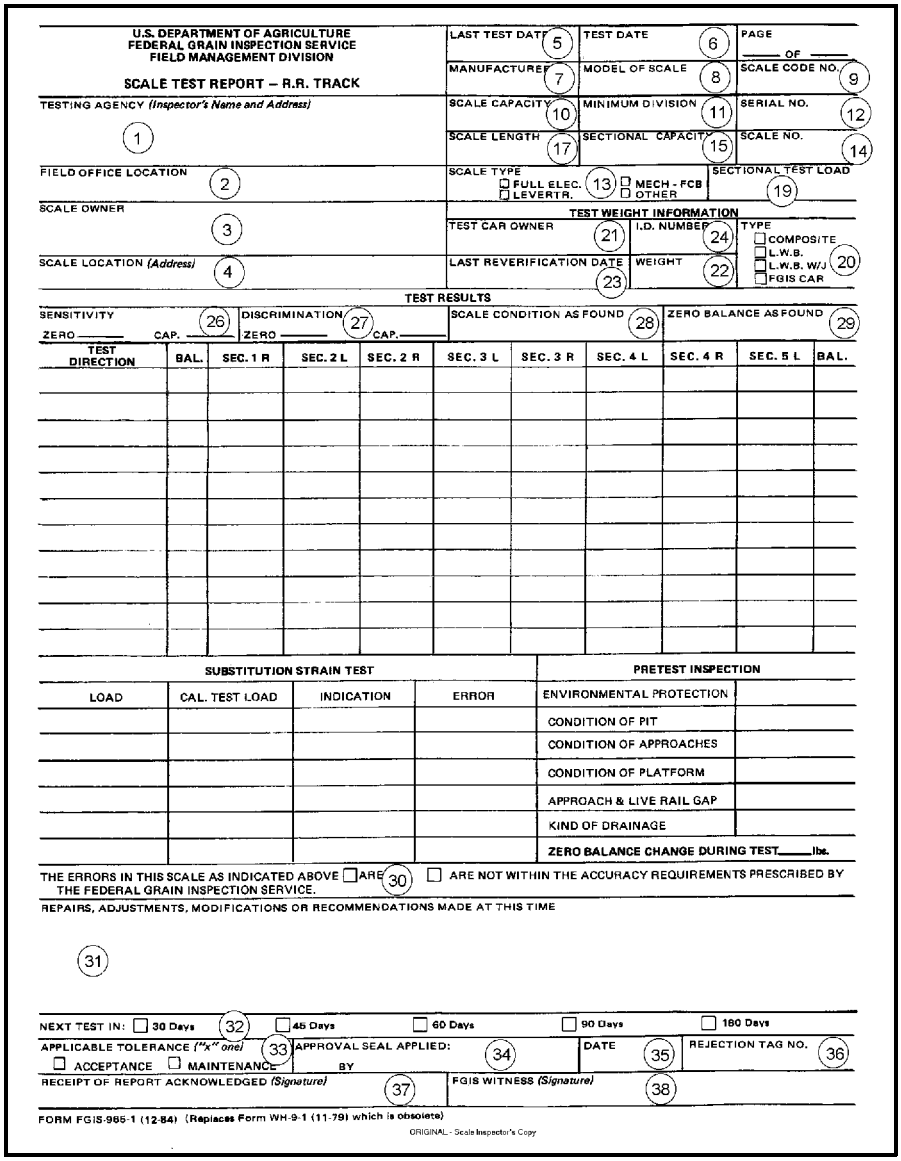
NEXT TEST IN: ☐ 30 Days (32) ☐ 45 Days ☐ 60 Days ☐ 90 Days ☐ 180 Days

APPLICABLE TOLERANCE ("x" one) ☐ ACCEPTANCE (33) ☐ MAINTENANCE | APPROVAL SEAL APPLIED BY (34) | DATE (35) | REJECTION TAG NO. (36)

RECEIPT OF REPORT ACKNOWLEDGED *(Signature)* (37) | FGIS WITNESS *(Signature)* (38)

FORM FGIS-965 MAY 95 (Edition dated (12-84) is usable) ORIGINAL - Scale Inspector's Copy

Scale Test Report -- Railroad Track



U.S. DEPARTMENT OF AGRICULTURE
FEDERAL GRAIN INSPECTION SERVICE
FIELD MANAGEMENT DIVISION

SCALE TEST REPORT – R.R. TRACK

TESTING AGENCY *(Inspector's Name and Address)* (1)

FIELD OFFICE LOCATION (2)

SCALE OWNER (3)

SCALE LOCATION *(Address)* (4)

LAST TEST DATE (5) | TEST DATE (6) | PAGE ____ OF ____

MANUFACTURER (7) | MODEL OF SCALE (8) | SCALE CODE NO. (9)

SCALE CAPACITY (10) | MINIMUM DIVISION (11) | SERIAL NO. (12)

SCALE LENGTH (17) | SECTIONAL CAPACITY (15) | SCALE NO. (14)

SCALE TYPE (13): ☐ FULL ELEC. ☐ LEVER TR. ☐ MECH - FCB ☐ OTHER | SECTIONAL TEST LOAD (19)

TEST WEIGHT INFORMATION

TEST CAR OWNER (21) | I.D. NUMBER (24) | TYPE (20): ☐ COMPOSITE ☐ L.W.B. ☐ L.W.B. W/J ☐ FGIS CAR

LAST REVERIFICATION DATE (23) | WEIGHT (22)

TEST RESULTS

SENSITIVITY (26): ZERO ____ CAP. ____ | DISCRIMINATION (27): ZERO ____ CAP. ____ | SCALE CONDITION AS FOUND (28) | ZERO BALANCE AS FOUND (29)

TEST DIRECTION	BAL.	SEC. 1 R	SEC. 2 L	SEC. 2 R	SEC. 3 L	SEC. 3 R	SEC. 4 L	SEC. 4 R	SEC. 5 L	BAL.

SUBSTITUTION STRAIN TEST

LOAD	CAL. TEST LOAD	INDICATION	ERROR

PRETEST INSPECTION

ENVIRONMENTAL PROTECTION	
CONDITION OF PIT	
CONDITION OF APPROACHES	
CONDITION OF PLATFORM	
APPROACH & LIVE RAIL GAP	
KIND OF DRAINAGE	
ZERO BALANCE CHANGE DURING TEST____lbs.	

THE ERRORS IN THIS SCALE AS INDICATED ABOVE ☐ ARE (30) ☐ ARE NOT WITHIN THE ACCURACY REQUIREMENTS PRESCRIBED BY THE FEDERAL GRAIN INSPECTION SERVICE.

REPAIRS, ADJUSTMENTS, MODIFICATIONS OR RECOMMENDATIONS MADE AT THIS TIME

(31)

NEXT TEST IN: ☐ 30 Days (32) ☐ 45 Days ☐ 60 Days ☐ 90 Days ☐ 180 Days

APPLICABLE TOLERANCE *("x" one)* (33) ☐ ACCEPTANCE ☐ MAINTENANCE | APPROVAL SEAL APPLIED: BY (34) | DATE (35) | REJECTION TAG NO. (36)

RECEIPT OF REPORT ACKNOWLEDGED *(Signature)* (37) | FGIS WITNESS *(Signature)* (38)

FORM FGIS-965-1 (12-84) (Replaces Form WH-9-1 (11-79) which is obsolete)

ORIGINAL - Scale Inspector's Copy

Scale Test Report -- Vehicle

U.S. DEPARTMENT OF AGRICULTURE
FEDERAL GRAIN INSPECTION SERVICE
FIELD MANAGEMENT DIVISION

SCALE TEST REPORT - VEHICLE

LAST DATE TESTED (5)	TEST DATE (6)	PAGE ____ OF ____	
MANUFACTURER (7)	MODEL OF SCALE (8)	SCALE CODE NO. (9)	
SCALE CAPACITY (10)	MINIMUM DIVISION (11)	SERIAL NO. (12)	
PLATFORM SIZE ____ X ____ FT. (16)	SECTIONAL CAPACITY (15)	SCALE NO. (14)	
SCALE TYPE ☐ FULL ELEC. ☐ ELEC. DIAL ☐ LEVERTR ☐ MECH. DIAL (13)		LOAD CELL CAPACITY (18)	

TESTING AGENCY *(Inspector's Name, Address)* (1)

FIELD OFFICE LOCATION (2)

SCALE OWNER (3)

SCALE LOCATION (4)

TEST WEIGHT INFORMATION

TEST WEIGHT OWNER (21) | TYPE AND MFG. (20)

TOTAL WEIGHT (22) | LAST REVERIFICATION DATE (23)

TEST RESULTS

SENSITIVITY ZERO _____ CAP. ____ (26) | DISCRIMINATION (27) ZERO _____ CAP. _____ | SCALE CONDITION AS FOUND (28) | ZERO BALANCE AS FOUND (29)

SHIFT TEST DIRECTION	BAL.	SECTION 1	SECTION 2	SECTION 3	SECTION 4	SECTION 5	SECTION 6	BAL.
SECTION TEST								

INCREASING LOAD TEST

LOAD	TEST WEIGHT	WEIGHT INDICATION	ERROR WEIGHT	ERROR

STRAIN LOAD TEST

FACTORS	TEST NO. 1	TEST NO. 2
EMPTY TRUCK WEIGHT		
TEST WEIGHT ADDED		
TRUCK AND WEIGHT INDICATION		
ERROR ON WEIGHT ADDED		
CONDITION OF PIT		
CONDITION OF APPROACHES		
CONDITION OF PLATFORM		
KIND OF DRAINAGE		

RECORD BALANCE CHANGE _____ lbs.

THE ERRORS IN THIS SCALE AS INDICATED ABOVE ☐ ARE ☐ ARE NOT WITHIN THE ACCURACY REQUIREMENTS PRESCRIBED BY THE FEDERAL GRAIN INSPECTION SERVICE (30)

REPAIRS, ADJUSTMENTS, MODIFICATIONS OR RECOMMENDATIONS MADE AT THIS TIME

(31)

NEXT TEST IN: ☐ 30 Days (32) ☐ 45 Days ☐ 60 Days ☐ 90 Days ☐ 180 Days

APPLICABLE TOLERANCE (Tons) ☐ ACCEPTANCE (33) ☐ MAINTENANCE | APPROVAL SEAL APPLIED BY (34) | DATE (35) | REJECTION TAG NO. (36)

RECEIPT OF REPORT ACKNOWLEDGED *(Signature)* (37) | FGIS WITNESS *(Signature)* (38)

FORM FGIS-965-2 (12-84) (Replaces Form WH-9-2 (2-79) which is obsolete.)

ORIGINAL - Scale Inspector's Copy

ATTACHMENT 4
WEIGHING HANDBOOK
CHAPTER 3
3.1 GENERAL
9/20/96

Instruction for Completing Scale Test Reports

1 Testing Agency. The name and address of the organization performing the test. Include the name of the scale tester. If an elevator employee is performing the test, the person's name is sufficient.

2 Field Office Location. The city and state of the field office which has jurisdiction for the scale being tested.

3 Scale Owner. Facility name and designation; i.e., Mid South Grain, House A.

4 Scale Location. The street address of the elevator.

5 Last Date Tested. Date of the last test.

6 Test Date. The month, day, and year of the test.

7 Manufacturer. The name of the company, corporation, person, etc., who manufactured the indicating element.

8 Model of scale. The model name, number, or designation which has been assigned by the manufacturer.

9 Scale Code No. The code number of the scale which was assigned by the FGIS Weighing and Equipment Branch for use in the ADP Scale Test Monitoring System.

10 Scale Capacity. The maximum gross load that can be accepted for official weight certification as determined by an official scale inspector.

11 Minimum Division. The value of the smallest unit that can be indicated on the primary indicating element during normal weighing.

12 Serial No. The nonrepetitive number which was assigned by the manufacturer and affixed to the indicating element or beam.

13 Scale Type. Check the appropriate box to indicate whether the scale is full electronic, levertronic, a full capacity beam (FCB) mechanical scale, or a counterpoise (CPB) mechanical scale.

14 Scale No. The number assigned to the scale by the owner which usually includes S and/ or R designations to differentiate between shipping and receiving.

15 Sectional Capacity. The maximum gross load that can be applied to any one section of the scale without causing structural deflections affecting the accuracy of the scale.

16 Platform Size. The length and width of the vehicle scale platform.

17 Scale Length. The length of the live track on a railroad track scale.

18 Load Cell Capacity. The manufacturer's rated capacity of one of the load cells in the scale system.

19 Sectional Test Load. The maximum amount of test standards applied to any one section of a railroad track or vehicle scale.

20 Type and Mfg. For vehicle and hopper scales indicate the type of test weights; i.e., fab, basket, cast, etc., and the manufacturer. For railroad track scales check the appropriate box.

21 Test Weight Owner. Indicate the test weight owner.

22 Total Weight. The total amount of the test weights combined.

23 Last Reverification Date. Indicate the month and year of the latest test weight reverification.

24 I.D. No. The identification of the test car.

25 Number of Weights. The total number of individual weights.

26 Sensitivity. The results of the sensitivity check in number of divisions at zero and at capacity.

27 Discrimination. The results of the discrimination check in number of divisions at ZERO and at CAPACITY.

28 Scale Condition as Found. Indicate the condition of the scale as found. (i.e., water in pit, dirty platform, etc.)

29 Zero Balance as Found. The weight indication on the primary indicating element with no load on the load receiving element at the time of starting the official inspection and test.

30 Results. Check appropriate box; /x/ ARE-for scales that are within tolerance or have been adjusted to be within tolerance, /x/ ARE NOT-for a scale that cannot be used for official weight certification because it cannot be adjusted or fixed and is consequently REJECTED.

31 Remarks. Indicate any repairs, adjustments, modifications, or recommendations. (i.e., scale serviced before test, load cell #2 replaced, A/D converter replaced.)

32 Next Test In. Check the appropriate box to indicate approximately when the next test is due.

33 Applicable Tolerance. ("X" one.) Indicate which tolerance is to be applied.

34 Approval Seal Applied. Indicate the name of the inspector who applied the FGIS Approved Label for Inspected Machinery. If the person is the same as the FGIS witness, just initial.

35 Date. Indicate the date of approval.

36 Rejection Tag No. Indicate the number of the rejection tag, if applicable.

37 Receipt of Report Acknowledged. Signature of the scale owner's representative.

38 FGIS Witness. FGIS or delegated official who observed the testing and approval of the scale.

3.2 FIELD STANDARDS AND COUNTERPOISE WEIGHTS

a. General

Field standards and counterpoise weights shall include, but not be limited to, on-site block weights, portable block weights, and test weight kits; and shall conform to the specifications and tolerances established by the National Institute of Standards and Technology (NIST) Handbook 105-1 (1990 edition), for field standard weights.

b. Class F Tolerances for Field Standard Weights

The tolerances are one part in 10,000 for weights 1 kg (2 lb) and larger, 70 mg for weights between 1 kg and 300 g, and one part in 5,000 for weights 300 g down to and including 10 g. Tolerances for weights below 10 g are determined from the equation:

$$T(W) \text{ in mg} = 0.9\ W^{0.31795}$$

Where W is the nominal value in grams. Tolerances in the tables on page 3-18 have been rounded to two significant digits.

For weight denominations smaller than 1 kg (2 lb), intermediate between those values listed in the tables, the tolerance for the lower denomination shall be applied. The prescribed tolerances shall be applied equally to errors in excess and errors in deficiency.

c. Field Standard Values

(1) Railway Test Cars Under FGIS Jurisdiction

The stenciled weight of a test car or monitor car shall be in 1,000-pound intervals.

(2) Vehicle and Hopper Scales

Field standard weights for vehicle and hopper scales shall be sealed to a 50-pound interval.

(3) Numbering Field Standards

Elevator field standards shall be numbered so they may be properly identified.

Class F Weight Tolerance Chart

Class F Tolerances for Field Standard Weights

Avoirdupois					Metric	
Denomination	Tolerance		Denomination	Tolerance	Denomination	Tolerance
10 000 lb	1.0 lb	450 g	8 oz	45 mg	500 kg	50 g
5 000	0.50	230	4	23	300	30
3 000	0.30	140	2	11	200	20
2 500	0.25	110	1	5.4	100	10
2 000	0.20	91	0.5 (½)	2.8	50	5.0
1 000	0.10	45	0.3	1.8	30	3.0
500	0.050	23	0.25 (¼)	1.7	20	2.0
100	0.010	4.5	0.2	1.6	10	1.0
50	0.0050	2.3	0.125 (⅛)	1.3	5	.50
30	0.0030	1.4	0.1	1.3	3	.30
25	0.0025	1.1	0.0625 (1/16)	1.1	2	.20
20	0.0020	0.91	0.05	1.0	1	.10
10	0.0010	0.45	0.03125 (1/32)	0.87	500 g	70 mg
5	500 μlb	230 mg	0.03	0.85	300	60
3	300	140	0.02	0.75	200	40
2	200	91	0.015625 (1/64)	0.69	100	20
1	150	70	0.01	0.60	50	10
0.5	100	45			30	6.0
0.3	60	27			20	4.0
0.2	40	18			10	2.0
0.1	20	9.1			5	1.5
0.05	10	4.5			3	1.3
0.03	6.0	2.7			2	1.1
0.02	4.0	1.8			1	0.90
0.01	3.2	1.5			500 mg	0.72
0.005	2.6	1.2			300	0.61
0.003	2.2	0.99			200	0.54
0.002	1.9	0.87			100	0.43
0.001	1.5	0.70			50	0.35
					30	0.30
					20	0.26
					10	0.21
					5	0.17
					3	0.14
					2	0.12
					1	0.10

d. Care of Standards

(1) Covers

Standards exposed to the elements shall be kept covered or stored in a reasonably dry environment when not in use. Covers shall be required for weights that in the opinion of the Service are not being kept clean.

(2) Damage or Abuse

Any evidence of damage or abuse to the standard itself or the sealing cavity shall necessitate reverification of the standard.

NOTE: The sealing cavity shall be clearly marked with the date of reverification. Standards shall be repainted after "as found" data has been determined and before adjustments are made.

(3) Contact with Floors

Provisions shall be made so that field standard weights shall not have direct contact with a solid floor (i.e., by use of steel grating).

e. Reverification Frequency

(1) Large Field Standards

When reverifying large field standards, the approved laboratory shall clearly and conspicuously stamp the seal of the adjustment cavity with the year reverified and, upon request, provide appropriate documentation to the Service. Field standards approved by State Weights and Measures authorities must have an accompanying Report of Test (ROT) on file in order to be recognized as official standards.

(2) Basket Weights

Open baskets shall be sealed to a 50-pound multiple and shall be tolerance tested and treated as a normal standard.

Closed baskets shall be sealed as an integral part of composite summation. The closed basket shall be designed in such a manner to incorporate a fitted cover plate which shall be locked during calibration. A pre-numbered seal shall be included as part of the weight value. Once tested, the basket shall be sealed with the pre-numbered seal and the number shall be recorded in the Scale Record Log (FGIS-963).

(3) On-site Block Weights and Closed Basket Weights Without Casters

These weights shall be reverified every 3 years. This category shall include large one-piece standards and sealed baskets containing weights.

(4) Counterpoise Weights, Field Standard Weights up to and Including 50 Pounds, and Sealed Baskets with Casters

These weights shall be reverified each 3 years.

(5) Portable Block Weights

These weights shall be reverified at least every 3 years. Portable block weights shall be construed to mean one piece standards utilized by approved testing agencies. Documentation of the reverification date shall be supplied to FGIS upon request.

(6) Railway Track Scale Test Cars

Test cars utilized in the testing of railroad track scales under the jurisdiction of FGIS shall be reverified at least annually. Documentation indicating date and location of last reverification shall be supplied to FGIS upon request.

(7) Chains, Hangers, and Baskets

Any chains or hangers utilized for suspending test weights, when balanced as part of the zero-load of the scale, need not be reverified.

(8) Fabricated Field Standards

In cooperation with the National Institute of Standards and Technology FGIS has determined that fabricated (filled shell) and laminated weight designs are no longer acceptable. These types of weights have not shown the necessary stability for maintaining tolerances during test cycles.

(a) No new fabricated weight shall be placed into service.

(b) A fabricated weight in service, that has maintained Class F tolerances between verification tests, shall continue to be acceptable. These weights shall be tested every 3 years.

(c) Fabricated weights found to be out of tolerance at the time of a verification test shall be adjusted as close as possible to zero error, and allowed to remain in service for 1 year. During the 1 year period, the owner must arrange to replace the weight, since it will be condemned and removed from service on the anniversary date of the test.

(d) Notification of official rejection of test weights will be made by a letter from the Director of the FGIS, Field Management Division to the manager of the elevator after a thorough review of the data.

(9) FGIS-Owned Field Standard Weights and Counterbalance Weights

These weights shall be reverified each 3 years. Official agencies are required to have their standard weights and counterbalance weights reverified in a similar manner.

Note: Reverification should be performed by NIST certified State Weights and Measures Metrology Laboratories, when practicable. If not practicable, contact the FGIS, Weighing and Equipment Branch, to make other arrangements.

Reverification Schedule for FGIS-Owned
Field Standard Weights

Type	Reverification Frequency	Tolerance
1. Field Standard Weights		
a. Commodity weights (1, 2, 5, 10, 25, and 50 pounds)	3 years	NIST Class F
b. Metric weight kits:		
1) Class P Brass [1]	3 years	NIST Class P
2). All other kits	3 years	NIST Class F
c. Pounds per bushel weights	3 years	
2. Laboratory Counterbalance Weights[2]	3 years	NIST Class F

f. Test Weight Reverification (TWR)

(1) General

The FGIS TWR program is a National Institute of Standards and Technology, Office of Weights and Measures recognized program, which is accepted by most states having official grain scales. The TWR service is provided by FGIS to facilities that do not have access to State Weights and Measures metrology services. The service entails a procedure for checking facility test weights at the facility, adjusting the weights, and providing a ROT.

[1]Used only for testing weighing devices. FGIS discourages the purchase of weights other than Class F. Other classes may be used if a State metrology laboratory has certified them. The same applies to old NBS circular ***Class S-1 weights***. In addition, Class S-1 weights ***shall be reverified annually***. Class S-1 weights have accuracy tolerances so small that they must be handled by wooden or ivory forceps, chamois skin, or special lifters so grease cannot be left on, or damage the weights.

[2]Counterbalance weights are those used with a weighing device to make weight determination; e.g. Shadograph weights, stainless steel metric weights, and Toledo scale weights.

(2) TWR Equipment Setup

A location for TWR must be selected such that reverification of the test weights can be performed with minimal effects from environment and elevator operations. The following conditions are necessary for accurate use of the TWR equipment.

(a) The test station should be located in a place convenient for moving the weights to and from the scales.

(b) Walk-by traffic should be minimized.

(c) There should be no heating sources or drafts in the immediate area.

(d) There should be no direct sunlight on the TWR equipment.

(e) The facility must provide one or more handling carts and labor to move the weights from the scale to the test station and back.

(f) The reverification loadcells are designed to be suspended under a structural steel "I" beam similar to the drawing shown in Attachment 5.

1) The elevator must provide a structural steel bridge anchored in such a manner to support loads at least four times as great as the largest test weight to be applied.

2) The structural steel bridge "I" beam must measure 10 inches deep by 6 inches wide flange or conform to the drawing if the bridge is constructed by bolting two 10 inch channel beams back-to-back.

(g) The supporting steel shall be level and a minimum of 10 feet in length if free standing or set perpendicular to a wall; or a minimum of 15 feet if set diagonally on a corner angle.

1) A minimum clearance of 48 inches is required between the closest wall and center line of the steel bridge.

2) The height of the structural steel bridge, as measured from the bottom flange to the concrete floor, should be 96 inches or more.

(h) The basket, channels, and 50-pound weights must have been calibrated by an approved weights and measures laboratory. The correction weights need a ROT or calibration report. At the test station, the summation is adjusted using the correction weights to bring it to the required nominal value.

(3) TWR Procedure - Electronic Mass Comparator

(a) The comparator is composed of three main parts: the lifting linkage, measuring instrument, and load cell. The lifting linkage has a hydraulic cylinder with clevis eye, rod end bearings, and clevis. The assembly of the linkage, connectors, and hooks must be carefully examined. Do not use any equipment that shows signs of fatigue or wear. The linkage must be assembled as shown in Attachment 6. No chains may be used.

(b) Select the 2K load cell for weights from 500 pounds to 2,000 pounds. Use the 5K load cell for weights over 2,000 pounds up to 5,000 pounds.

(c) Instrument Set-Up

The electronic instrument is not explosion-proof; however, it is suitable for use in most areas of the grain elevator, if facility management approval is obtained. It must be set up according to manufacturer's instructions.

1) Warm up the instrument for at least 1 hour. Keep the dust-tight case closed to stabilize the temperature.

2) Select auto calibration OFF, 6-wire load cell connection, filter 4, tare OFF.

3) Program the instrument as shown in Attachment 7. This will ensure that the division size is appropriate and that the instrument is spanned properly.

(d) Check sensitivity

First exercise the cell by lifting and lowering a weight until the readings appear stable. The instrument reading should change an amount equal to the sensitivity weight added to the weight. The sensitivity weight should be equal to twice the allowable tolerance for the test weight being reverified. Example: For a 2,500-pound test weight, use a 0.5 pound sensitivity weight.

(e) Load the standard with correction weights. Raise it gently with the hydraulic cylinder. During the test procedures do not shock the load cell or treat it roughly since this is a possible source of shift. The instrument indication should be completely stable after approximately 45 seconds. Record the indication; note that it will not indicate the correct weight of the standard because this is not a direct reading scale -- it is used to compare differences in mass.

(f) Lower the standard to a cart with casters that is used for temporary storage during the test cycle.

(g) Load the first house weight. Raise it gently with the hydraulic cylinder. The instrument indication should be completely stable after approximately 45 seconds. Record the indication. Lower the weight.

(h) Repeat items (e) and (f). This provides the third instrument reading necessary to determine a value for the house weight. Three readings are needed to compensate for the slow drift that is normal for the instrument. The standard value must not change by an amount greater than the tolerance applied for the size weight being tested. Normally, the comparator will perform much more consistently than this limit.

(i) Calculate the difference between the standard and the house weight. Use the modified substitution equation:

$$d = O_2 - \frac{(O_1 + O_3)}{2}$$

Where d = difference between the weights in pounds
O_1 = First reading for the Standard
O_2 = Reading for the House weight
O_3 = Last reading for the Standard

Example: 3,000-pound weight

Observation O_1 Standard 2998.90
Observation O_2 House Weight 2999.05
Observation O_3 Standard 2999.00

Observation O_1 = 2998.90
Plus Observation O_3 = 2999.00 = 5997.90

divided by 2 = 2998.95

Observation O_2 House Weight 2999.05 - 2998.95 = 0.10 lb
In Tolerance

(j) Because of the uncertainties of the comparator, we must have the weight difference ≤ ½ tolerance. Adjust the weight, if needed. Refer to item (4) below for adjustment procedures. After adjustment the series of three observations must be repeated in its entirety.

NOTE: Obtain permission from the elevator manager to adjust the weight. This first elevator house weight will be used as a control standard to be compared periodically against the summation standard.

(k) If the operator feels that the data indicates a system change, the control standard may be used to verify the change. The control standard is the first house weight that was tested and adjusted, if necessary, and placed near the comparator to be used to ensure repeatability of the system.

(l) Update the lead seals of all weights approved by flattening the seal, as necessary, with a drift and stamping "FGIS-MO/YR." The same technique applies to adjusted weights where new seals are made. Record this final action.

(4) Adjusting Procedure

(a) Carefully remove the lead seal with a punch. If it is damaged, cut a new one from a sheet of lead and discard the damaged one before proceeding.

(b) Remove the seal backing plate and plug. Normally this requires a ⅝-inch key steel.

(c) Remove adjusting material if the weight is too heavy. Use grabbers or a spoon-type scoop and remove larger pieces first. Be sure you remove slightly more than enough material indicated by the instrument. Place the pieces and shot in a light paper cup.

(d) Reload the house weight on the comparator. Put the cup, plug, backing plate, and good lead seal, on top of the weight.

(e) Adjust to achieve zero error condition by adding or removing lead shot.

(f) Test the weight after adjustment by performing the series of three observations.

(g) Replace all parts of the adjustment cavity; use a punch to flatten the lead seal. Imprint "FGIS-MO/YR" on the seal.

(5) Documentation of Results

TWR readings, the amounts of error weights, the amount of correction weights, and amount of sensitivity weights applied to the standard or the weight being reverified must be recorded.

(a) Cover and Information Sheet

This sheet is used to document the following historical information. (See Attachment 8).

1) Name of manager or superintendent

2) Name of company (elevator name) and date

3) Complete mailing address, including zip code

4) Code numbers for each group of weights

5) Size

6) Type of weights - cast, fabricated, other

7) Name of test weight manufacturer

8) Last reverification date (from weight seal)

9) Dimensions, size, and location of adjusting cavity should be indicated on the drawings.

(b) Test Weight Reverification Data and Calibration Report

This report is used as a worksheet for recording observations and computing error while performing the reverification (See Attachment 9). The following information is shown on the report.

1) Elevator: Elevator name

2) Location: City and state

3) Temperature: Approximate temperature near TWR equipment.

4) Correction: Enter the correction weight and color code for the summation standard being used.

5) Sheet No.: Maintain numbering sequence

6) Date(s): Date(s)

7) Observer: TWR personnel name

8) Comparator Number: TWR equipment designation

9) Description of Load: Enter the designation of the load, FGIS weight code number, or FGIS 50-pound standards and the amount of any correction weights. Use the word "ditto" to indicate the same description of load as previously indicated. The initials S.W. should be used to indicate when a sensitivity weight is applied. The amount of the weight must follow the S.W.

10) Observations: Enter the display value for the standard. If a control standard reading is being taken, write the words, CONTROL STD.

11) Computations: The results of the sensitivity check, the amount of error found in an elevator weight and any other notations pertinent to the reverification procedure are placed in this column.

12) Remarks: Note whether a house weight was left with error and in tolerance or whether the weight was adjusted. Any other pertinent remarks may be placed in this column.

(c) TWR Summary Report

This report is used to summarize the results of all the weights at a particular elevator. The following information is used to update the computer records at headquarters (See Attachment 10).

1) Elevator: Elevator name

2) Location: City and state

3) Date(s): Date(s) of TWR

4) FGIS Weight Code Number: The assigned code number for each weight tested.

5) Type of Weight: Indicate whether the weight is cast (CA) or fabricated (FAB).

6) Weight Value: The nominal weight of the house weight in pounds.

7) Pounds of Error: Indicate the amount that the house weight is light (-) or heavy (+).

8) Adjustment (N/A = Not Adjusted): Indicate the error in the weight after adjustment.

9) House Weight Code Number

10) Scale Number

g. Calibration of Test Car Test Weights

(1) Purpose and Background

(a) Each of FGIS' three railway track scale test cars (FGWX 100,000, FGWX 200,000, and FGWX 300,000) are equipped with either nine or ten, 10,000-pound block weights and one 10,000-pound dolly. These are used for railway scale testing, calibration of master scales, and field calibration of railway scale test cars.

(b) FGIS maintains standard weights traceable to NIST at the Master Scale Depot, Chicago, Illinois. They are used with a 5-ton comparator to calibrate the test car weights and dollies.

(c) Test weights must be recalibrated once a year.

(2) Preliminary Setup

(a) Inspect the weights. The weights and dolly must be clean and free of corrosion or peeling paint. If necessary, they must be stripped and repainted. Use a zinc chromate primer and an aluminum spray finish.

(b) Check the dolly. Make any needed repairs. Fill the oil reservoir to the line on the visual gage.

(c) Visually check the 5-ton comparator. The platform and other moving parts must not bind. Examine bolts, connectors, chains and hooks. Do not use equipment that shows signs of wear or fatigue.

(d) Place the weight cradle on the scale platform. Put rubber pads on the ends to cushion the weights.

(e) Position the weights. Place the standard and the weight to be calibrated at either side of the comparator. The overhead crane should not need to be positioned; only the traversing trolley needs to be moved during the calibration.

(f) Check the most recent report of calibration for the standards. Ensure that the corrections for apparent mass are used in your calculations.

(g) Check the tare weights (trim). A recent ROT to Class F tolerances is required.

(h) Prepare data sheets. Fill in the heading of the data sheet with the date, operator, standard I.D., check standard I.D., and test weight identification.

(3) Procedure (Double Substitution 3-1 Weighing Design)

(a) For safety, two people must be present when moving or testing weights at the Master Scale Depot.

(b) Place counterpoise weights equal to 10,000 pounds on the tip end of the beam.

(c) Place the standard 10,000 pound-weight (S) on the platform. Avoid shock loading.

1) Add 2.0 pounds of tare, release the beam, and balance the scale.

2) Read the turning points of the beam. The sum should be near to 20 divisions. If necessary, adjust the tare until the proper sum is obtained.

3) Arrest the beam. Remove the standard and tare.

(d) Place the test weight (W1) on the platform.

1) Release the beam. Add the required tare. Observe the turning points; add or remove tare to keep the turning points on scale.

2) Read the turning points and record them.

(e) Add a 0.1-pound sensitivity weight to W1 (and tare). Read and record the turning points. Arrest the beam.

(f) Remove the W1 weight, tare, and sensitivity weight.

(g) Place the S weight on the platform.

1) Add the same tare as in step (3) (c) 2) Normally, this will keep the beam on scale, but adjust the tare, if necessary.

2) Add a 0.1-pound sensitivity weight to S. Read and record the turning points. Arrest the beam.

(h) Remove the S weight, tare, and sensitivity weight.

(i) Repeat steps a through h using standard (S) and check standard (W2).

(j) Repeat steps a through h using W1 and W2.

(4) Calculations

(a) Use the "3-1 Weighing Sheet" (Attachment 11).

(b) Sum the turning points for the comparisons of S and W1. They will be 0_1, 0_2, 0_3, and 0_4, respectively.

(c) Calculate a1; a1 = S - W1

$$S - W1 = a1 = \frac{(0_1 - 0_2 - 0_3 + 0_4)}{2} \frac{(0.1)}{0_3 - 0_2} + t_S - t_{W1}$$

S = Standard weight
W1 = Test weight
0_1 through 0_4= Sums
t_S = tare with S
t_{W1} = tare with W1

NOTE: If the tare carried with S changed during the observations, use the average tare. If W1 tare changed, average it, also.

(d) Calculate a_2; a_2 = S - W2

(e) Calculate a_3; a_3 = W1 - W2

(f) Use the equations shown on the "3-1 Weighing Sheet" to derive values for:

1) Standard deviation

2) W1 correction

3) W2 correction

(g) Check the value for W1. It should be ± 0.1 pound.

(h) Check the value of W2. Compare it to the last reported value according to control charts maintained under the NIST Laboratory Metrology Program. It must agree within the uncertainty limits of the comparator. If not, examine the comparator and calculations. Retest the weights, if necessary.

(i) Issue a "Report of Calibration" (Attachment 12) showing all W1 values and uncertainties. The sum of these is used as the correction.

h. Railway Track Scale Test Car Calibration

(1) Specifications

(a) Association of American Railroads (AAR) specifications for railway track scale test cars are contained in the 1996 edition of the AAR, Engineering Division, "Scale Handbook". These are general requirements for the construction of the various types of test cars such as, self-contained composite, standard railcar, and self-propelled.

(b) Test cars must be properly cleaned and painted and all repairs completed before arrival at the master scale.

(c) Annual calibration of all railway track scale test cars is required.

(2) Tolerances. AAR, Engineering Division, "Scale Handbook", Section 1.4.1, requires that test cars meet Class F tolerances.

(3) Test Instrumentation - Cars will be calibrated only on approved master railway track scales. Requirements for these scales are found in the AAR Scale Handbook, Section 4.0.

(a) $d \leq 2$ lb

(b) Annual testing under the AAR/FGIS master railway track scale testing program.

(c) Protected from environment

(4) Test Standards - Traceability to NIST - FGIS maintains mass standards of 10,000-pounds each, used in summation for testing master railway track scales and for use with other scales when performing field calibrations.

(5) Procedure

(a) Set up

1) Clean the test car.

2) Check for loose parts, etc.

3) Check any available records.

4) A self-propelled car must have its fuel tank filled prior to calibration.

5) Visually inspect the scale.

6) If using error weights, there should be 20 pounds available, with the smallest weight being 1 pound. They must have a current ROT.

(b) Readings

1) Set up the scale with no load, no drop-weights or counterpoise weights, and the sliding poise set at 50.0 pounds. Balance the scale. This is the zero reference for all future weighings on the scale. Arrest the beam, release, and repeat the reading to show repeatability.

2) Apply the drop-weights or counterpoise weights to the beam in an amount appropriate for the size of the test car to be calibrated (e.g., 100,000 pounds).

3) Position the test car on the center of the scale.

4) Move the sliding poise to attain equilibrium of the beam, and indicate the weight value of the test car. Use a correction for the known error in the scale.

5) Arrest the beam. Release and repeat reading.

6) Adjust the test car by adding or removing stable, metal adjusting material.

7) Remove the test car and recheck zero. Arrest, release, and repeat.

8) Reposition the test car on the center of the scale and move the sliding poise to attain equilibrium of the beam. This reading determines the "as released" error. Arrest, release, and repeat.

9) Remove the test car and recheck zero. Arrest, release, and repeat.

(c) Marking Requirements

1) Stencil the nominal value of the test car the date and location of calibration. Test cars under FGIS jurisdiction shall be stenciled in 1,000-pound increments.

2) The value as released must equal nominal stenciled value +/- Class F tolerance (1 part in 10,000). For a 100,000-pound car, this tolerance is 10 pounds.

(6) Documentation

(a) Records - FGIS maintains the following records that serve to document the traceability of the test car calibration to national standards. The records also document the level of accuracy in the program.

1) Report of Calibration - FGIS Primary Standards

2) Report of Calibration - FGIS Field Standards

3) Measurement Assurance Program Records

4) Master scale test record

5) Test Car calibration work sheet

6) Report of Railway Track Scale Test Car Calibration

(b) Report Format - Each test car calibration is recorded by issuance of a Report of Railway Track Scale Test Car Calibration (Attachment 13)

i. Field Calibration of Test Cars

The FGIS Field Calibration Program is a NIST recognized program, which is accepted by most States. The field calibration service is provided by FGIS to the railroads that do not have access to a Master Scale, or they have a captive car. [A captive car is a test car that cannot be moved out of its location or terminal because of its equipment limitations.] The service involves a procedure for calibrating the cars on location; adjusting the cars, and providing a report of test.

(1) Procedure for Calibration

The track scale used for the calibration must be a mechanical beam scale with a sensitivity of 5 pounds.

(2) Visual Inspection

(a) Inspect the deck for wear and check for binds between the weigh rail and approach rail

(b) Inspect the scale pit for cleanliness and dryness.

(c) Inspect all mechanical connections of the lever system. While conducting this inspection, put the blade edge of a screw driver between the lever and the side of the clevis at the pivot point, and adjust the pivot point so there is equal distance on both sides between the clevis and the lever.

(d) Inspect the weighbeam, poise, butt connection, and counterpoise tip loop connections. Use the same procedure as employed in the inspection of the lever system.

(3) Preliminary Setup

(a) Attach the flexible pointer that is found in the butt-ratio weight kit to the trig loop.

(b) Attach a ruled chart to the weighbeam as close as possible to the tip clevis assembly.

(c) Set up a magnifying glass so that while reading the turning points there will not be a parallax between pointer and the graduated division on the ruled scale.

(4) Test Procedure

(a) The railroad track scale used for field calibration must be tested before test car's calibration.

(b) The section test on the railroad track scale shall be conducted bidirectionally; that is, from one direction, then repeating in the opposite direction.

(c) Normal positions of a test car are designated in order from left to right as: 1R, 2L, 2R, 3L, 3R, 4L, etc. The number representing the section and the letter, when affixed, indicates that the body of the car lies to the left or right of the section with one pair of wheels directly over the section.

(d) Use the test car to be calibrated for the strain test.

(5) Calibration Procedure

(a) Most test cars have a 7 foot wheel base, FGIS weight dollies have a 5 foot wheel bases. Mark a 7 foot area on the deck of the scale using the section with the least amount of error and good repeatability.

(b) Place the weight dolly with the amount of weight equal to the weight of the car on the first mark, add 50 pound test weight to be used as error weights.

(c) Place the poise in the notch for the weight of the dolly, and adjust the balance ball until the beam swings equidistant above and below the center mark of the ruled scale. Read the turning points of the beam. The sum should be near to 20 divisions. If necessary adjust the balance ball until the proper sum is obtained. Record the results.

(d) Arrest the beam and move the weight dolly 2 feet. Release the beam and observe the turning points; add or remove error weights to keep the turning points on the scale. Read the turning points record them and the amount of error weights.

(e) Add a 5 pound sensitivity weight to the weight dolly. Read the turning points and record.

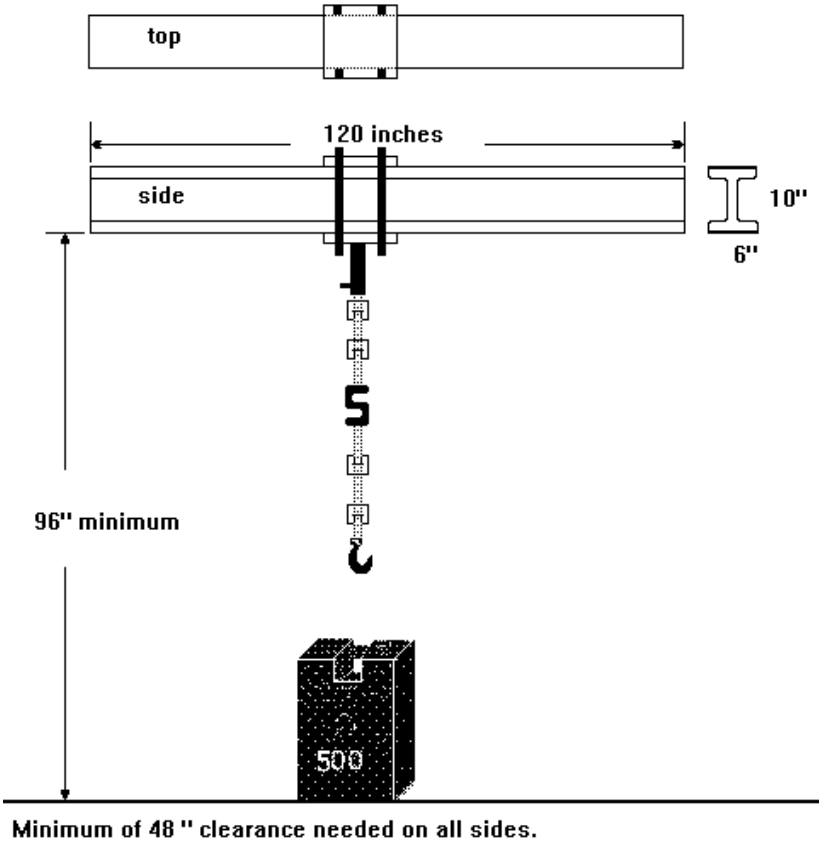
(f) Remove the weight dolly and the 5 pound sensitivity weight and place the test car on the marks. Add or subtract error weights until the turning points are within the sum of 20. Read and record the turning points. Arrest the beam.

(g) Remove the test car from the scale and repeat Step f.

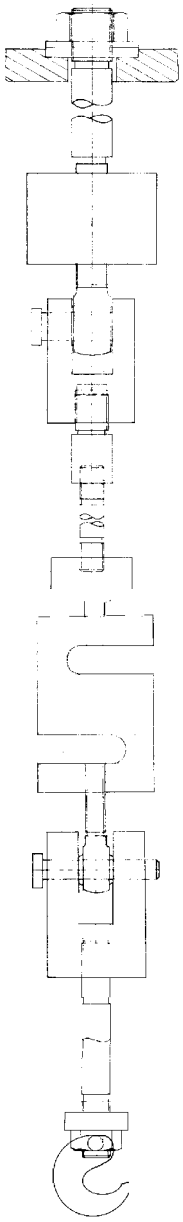
(h) Repeat steps c and d

(i) Complete the data sheet and issue a "Report of Calibration"

TWR Setup


top
120 inches
side
10"
6"
96" minimum
500
Minimum of 48 " clearance needed on all sides.

Electronic Mass Comparator Linkage Assembly



ATTACHMENT 7
WEIGHING HANDBOOK
CHAPTER 3
3.2 WEIGHTS
9/20/96

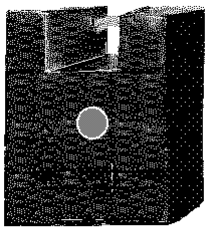
Electronic Mass Comparator Load Cell Program Values

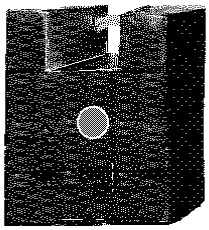
PROG. NO.	CELL	WEIGHT (lb) x D (lb)		
00	--	--	x	--
01	2K	500	x	.01
02	2K	1000	x	.02
03	2K	1500	x	.02
04	2K	2000	x	.02
05	5K	2000	x	.02
06	5K	2500	x	.05
07	5K	3000	x	.05
08	5K	3750	x	.1
09	5K	4000	x	.1
10	5K	5000	x	.1
11	--	--		--
12	--	--		--
13	--	--		--
14	--	--		--
15	--	--		--

Cover and Information Sheet

MANAGER	
COMPANY	
STREET LINE 1	
STREET LINE 2	
CITY, STATE ZIP	

CODE	SIZE	TYPE	MFG	LAST DONE





DESIGN: Show dimensions, location of adjustment cavity, etc.
Mark *CAST*, *FAB* or *OTHER* under the weight to indicate its type.

GIPSA Metrologist_____

Test Weight Reverification Data and Recalibration Report

Test Weight Reverification Data and Recalibration Report

Elevator_____ Sheet _____ of _____

Location_____ Date_____

Temperature_____ Observer_____

$\sum S_{correction}$ _____ Comparator No._____

Description of Load	Observations	Computations	Remarks

TWR Summary Report

TWR Summary Report

Elevator

Location

Dates

GIPSA Weight Code No.	Type of Weight	Nominal Weight Value	Error as found	Error as left N/A=not adjusted	House Weight Code No.	Scale No.

Three and One Weighing Design

3-1 Weighing Sheet

Test No. _____ Sheet No. _____
Temp. _____ Date _____
Balance _____ Observer _____

$S_{correction}$ (K) = _____ S = _____ W1 = _____ W2 = _____

a1 = S - W1 a2 = S - W2 a3 = W1 - W2

Description of Load		Observations		Sums	Initial Computations	Data Development
						+a1 =
						-a2 =
						+a3 =
						Sum =
						* 0.577
						(S) =
					a1 =	standard deviation
						-2a1 =
						-a2 =
						+a3 =
						+3K =
						Sum =
					a2 =	Sum/3 = W1 =
						-a1 =
						-2a2 =
						-a3 =
						+3K =
						Sum
						Sum/3 = W2 =
					a3 =	

Report of Calibration

United States Department of Agriculture
Grain Inspection, Packers and Stockyards Administration
P.O. Box 96454
Washington, D.C.
20090-6454

Test No. 95-2398
April 10, 1995

Report of Calibration

Ten Mass Standards
for Testing Master Railway Track Scales

Identification FGWX 200,000

Submitted by:

United States Department of Agriculture
Federal Grain Inspection Service
Master Scale Depot
Chicago, Illinois

The items identified above have been compared to the primary standards of the Federal Grain Inspection Service. Calibration of these standards is traceable to the National Institute of Standards and Technology.

The identified weights have been found accurate within the Class F tolerance band as specified by NIST Handbook 105-1. These weights are appropriate for testing Master Railway Track Scales for a period of one year from the date of test at which time they should be recalibrated.

Tested by: J. Decker, Industrial Specialist, Washington, D.C.

Results of calibration attached.

Paul Hadyka, Industrial Specialist
Weighing & Equipment Branch

Report of Calibration (continued)

A-Series Weights. FGWX 200,000

DATE	A1	A2	A3	S	W2	W1	ID
16MAR95	0.59200	0.43947	-0.21471	0.03588	0.09825	-0.09573	A1
18MAR95	0.49319	0.50333	-0.09231	0.05911	0.04782	-0.01034	A2
17MAR95	0.47117	0.45789	-0.02222	0.00516	0.06209	0.04285	A3
18MAR95	0.54935	0.42187	-0.08421	0.02497	0.08070	-0.01793	A4
16MAR95	0.45384	0.46471	-0.00952	0.01176	0.05909	0.05636	A5
18MAR95	0.54053	0.49167	-0.21154	0.09386	0.07956	-0.07775	A6
17MAR95	0.46450	0.34333	-0.04231	0.04550	0.14738	0.07879	A7
17MAR95	0.45229	0.43462	-0.02500	0.00422	0.08483	0.06227	A8
17MAR95	0.48887	0.46905	-0.10000	0.04626	0.07468	0.00140	A9
16MAR95	0.57742	0.48421	-0.18158	0.05099	0.06225	-0.08987	CART
						========	
				Total Correction AM vs Brass		- 0.04995 *lb*	

Uncertainty = 3*(0.051) + 0.093 = 0.25 *lb*
each weight

Check Standard Data:

Variable	N	Mean	Std Dev	Minimum	Maximum
S	10	0.0394659	0.0259528	0.0042244	0.0938639
W2	10	0.0833467	0.0281971	0.0478168	0.1473803

NIST ROT 11/88 Std = 10,000.517 *lb*
NIST ROT 11/88 W2 = 10,000.092 *lb*

Long term S from FY95 Lap = 0.051 *lb*

$$\text{Uncertainty W2} = \frac{3*(0.051)}{\sqrt{108}} + 0.093 = 0.108 \text{ lb}$$

W2 UL = 0.200 *lb*
W2 LL = -0.016 *lb*

Report of Test

United States Department of Agriculture | Federal Grain Inspection Service | P.O. Box 96454 Washington, D.C. 20090-6454

November 6, 1995

Report of Test

Scale Test Car
CR 80057

Submitted by: Consolidated Rail Corporation
2001 Market Street, Section 10-B
Philadelphia, Pennsylvania 19101-1401

Date of Test: October 11, 1995

The railway track scale test car was calibrated on the Federal Grain Inspection Service master scale in Chicago, Illinois.

Test Car Number	Nominal Weight (pounds)	Error as Received (pounds)	Error as Released (pounds)
CR 80057	100,000	-12.0	3.0

Remarks: The test car is in good condition.
Test conducted by Fred Anderson.

Richard R. Pforr, Chief
Weighing and Equipment Branch
Field Management Division

cc: Louis T. Cerny, AAR
Fred Anderson

(Blank Page)

3.3 CLASSIFICATION OF REQUIREMENTS

a. Applicability

The requirements set forth in this section describe procedures, specifications, and other technical requirements for grain weighing equipment and related grain handling systems used in performing Class X or Class Y weighing services and inspection services under the Act.

b. General Requirements

(1) Identification

All equipment, except weights, shall be clearly and permanently marked for the purposes of identification with the following information:

(a) The name, initials, or trademark of the manufacturer or distributor;

(b) A model designation that positively identifies the pattern or design of the device;

(c) Except for equipment with no moving or electronic component parts, a nonrepetitive serial number; and

(d) The serial number shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required serial number (H-44, 1994, G-S.1.).

(2) Official Testing and Certification

All official testing shall be performed according to the instructions. Official certification and application of an "Approved Label for Inspected Machinery" (Approval Seal) shall be made only by FGIS, authorized delegated or designated State, or approved scale testing organization.

(3) Facilitation of Fraud

All equipment and all mechanisms and devices attached thereto, or used in connection therewith, shall be so constructed, assembled, and installed for use that they do not facilitate the perpetration of fraud. (H-44, 1994, G-S.2.)

(4) Permanence

All equipment shall be of such materials, design, and construction as to make it probable that, under normal service conditions:

(a) Accuracy will be maintained,

(b) Operating parts will continue to function as intended, and

(c) Adjustments will remain reasonably permanent. Undue stresses, deflections, or distortions of parts shall not occur to the extent that accuracy or permanence is detrimentally affected. (H-44, 1994, G-S.3.)

(5) Abnormal Performance

Unstable indications or other abnormal equipment performance observed during operation shall be brought to the attention of the equipment's owner or owner's representative. If immediate correction cannot be made, the scale shall be taken out of service until corrective action is taken and the accuracy of the scale recertified. (H-44, 1994, G-UR.4.2. in part)

(6) Use of Adjustments

Weighing elements and measuring elements that are adjustable shall be adjusted only to correct those conditions that such elements are designed to control and shall not be adjusted to compensate for defective or abnormal installation or accessories or for badly worn or otherwise defective parts of the assembly. Any faulty installation conditions shall be corrected, and any defective parts shall be renewed or suitably repaired, before adjustments are undertaken. Whenever equipment is adjusted, the adjustments shall be so made as to bring performance errors as close as practicable to zero value. (H-44, 1994, G-UR.4.3.)

(7) Suitability of Equipment

Official grain weighing equipment shall be suitable for the application for which

it is to be used, and shall conform to the requirements of these regulations as being correct with respect to elements of its design, including but not limited to its weighing capacity, its computing capability, the character, number, size, and location of its indicating or recording elements, and the value of its smallest division. (H-44, 1994, G-UR.1.1. in part)

(8) Environment

Equipment shall be suitable for the environment in which it is used including, but not limited to, the effects of wind, weather and radio frequency interference (RFI). (H-44, 1994, G-UR.1.2.)

(9) Interchange or Reversal of Parts

Parts of a device that may readily be interchanged or reversed in the course of field assembly or of normal usage shall be:

(a) So constructed that their interchange or reversal will not affect the performance of the device, or

(b) So marked as to show their proper positions.

(H-44, 1994, G-S.4.)

(10) Installation

A device shall be installed in accordance with the manufacturer's instructions, including any instructions marked on the device. A device installed in a fixed location shall be so installed that neither its operation nor its performance will be adversely affected by any characteristic of the foundation, supports, or any other detail of the installation. (H-44, 1994, G-UR.2.1.)

(11) Installation of Indicating and Recording Elements

A device shall be installed so that there is no obstruction between a primary indicating and recording element and the load receiving element; otherwise there shall be convenient and permanently installed means for direct communication, oral or visual, between an individual located at a primaryindicating or recording

element and an individual located at the load-receiving element. Radios are considered direct communication and are acceptable providing they are at all times available for use. (H-44, 1994, G-UR.2.2. in part)

(12) Method of Operation

Equipment shall be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment. Manufacturers are required to supply complete detailed operating instructions with the equipment and to FGIS. (H-44, 1994, G-UR.3.1. in part)

(13) Associated and Nonassociated Equipment

A device shall meet all performance requirements when associated or nonassociated equipment is operated in its usual and customary manner and location. (H-44, 1994, G-UR.3.2.; G-N.2.)

(14) Maintenance of Equipment

All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment in service at a single place of business found to be in error predominately in a direction favorable to the device user shall not be considered "maintained in a proper operating condition." (H-44, 1994, G-UR.4.1.)

c. Design of Indicating and Recording Elements and of Recorded Representations

(1) General

All weighing devices shall be provided with indicating or recording elements appropriate in design and adequate in amount. Primary indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the device. (H-44, 1994, G-S.5.1.)

(2) Weight-Recording Device

Each grain scale, except portable platform scales, shall be equipped with a weight-recording device.

(3) Permanence

Graduations, indications, or recorded representations and their defining figures, words, and symbols shall be of such character that they will not tend easily to

become obliterated or illegible. (H-44, 1994, G-S.5.2.5.)

(4) Provisions for Sealing

(a) Except on Class I scales, provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an electronic device.

(b) Except on Class I scales, a device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that affects the metrological integrity of the device can be made to any electronic mechanism. (H-44 1994, S.1.11.; G-S.8., and S.1.6. ABWS in part)

(c) Except on Class I scales, audit trails shall use the format set forth in the following table. (H-44 1994, S.1.11.; G-S.8., and S.1.6. ABWS in part)

Categories of Device and Methods of Sealing	
Categories of Device	Method of Sealing
Category 1: No remote configuration capability	Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability, but access is controlled by physical hardware Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.	The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 3: Remote configuration capability access may be unlimited or controlled through a software with (e.g., password)	An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but no more than 1000 records are required. ***(Note: Does not require 1000 changes to be stored for each parameter.)***

[Nonretroactive and enforceable as of January 1, 1995]

(5) Digital Indication and Representation

Digital elements shall be so designed that:

(a) All digital values of like value in a system agree with one another.

(b) A digital value coincides with its associated analog value to the nearest minimum graduation,

(c) A digital value "rounds off" to the nearest minimum unit that can be indicated or recorded.

(d) A digital zero indication includes the display of a zero for all places that are displayed to the right of the decimal point and at least one place to the left. When no decimal values are displayed, a zero shall be displayed for each place of the displayed scale division. (H-44, 1994, G-S.5.2.2.)

(6) Recording Sequence

Provision shall be made so that all weight values are indicated until the completion of the recording of the indicated value. (H-44, 1994, S.1.5. ABWS Code)

(7) Recorded Weight Identification

Gross weight, tare weight, net weight, subtotal, and total printed representations shall either be identified by a symbol clearly and accurately identifying the type weight printed, (e.g., G-Gross, T-Tare, N-Net, ST-Subtotal, TO-Total) or shall be identified as such on the ticket or tape on which they are printed.

(8) Change in Mode of Operation

All grain weighing automatic hopper scales shall be designed so that the mode of operation and each change in mode of operation is indicated on the printed record by a symbol, number, or word which clearly designates the mode in which the scale is operated; i.e., A-automatic, M-manual, SA-semiautomatic; 1-automatic, 2-manual, 3-semiautomatic.

(9) Capacity Indication

An indicating or recording element shall not display nor record any values when the gross load or platform (not counting the initial dead load that has been canceled by an initial zero-setting device) is:

(a) In excess of 105% of scale capacity. (H-44, 1994, S.1.7., ABWS Code, S.1.3. in part)

(b) The recording element shall not record gross loads in excess of 105 percent of capacity unless the recorded representation clearly

indicates that the system is in an overload condition; i.e., "overload."

The total value of weight ranges and of unit weights in effect or in place at any time shall automatically be accounted for on the reading face and on any recorded representation.

This requirement does not apply to: (1) single-revolution dial scales, (2) multi revolution dial scales not equipped with unit weights, (3) scales equipped with two or more weighbeams, nor (4) devices that indicate mathematically-derived totalized values.

(10) Size and Character

In any series of graduations, indications, or recorded representations, corresponding graduations and units shall be uniform in size and character. Graduations, indications, or recorded representations which are subordinate to or of a lesser value than others with which they are associated shall be appropriately portrayed or designated. (H-44, 1994, G-S.5.2.3.)

(11) Values

If graduations, indications, or recorded representations are intended to have specific values, these shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof, uniformly placed with reference to the graduations, indications, or recorded representations and as close thereto as practicable, but not so positioned as to interfere with the accuracy of reading. (H-44, 1994, G-S.5.2.4.)

(12) Dual Indications

On equipment designed to indicate or record in more than one unit of measurement, the values indicated or recorded shall be identified with an appropriate word, symbol, or abbreviation. (H-44, 1994, G-S.5.3.1. in part)

(13) Weight Entries to Recording Devices

The displayed weight on electronic or levertronic scales shall be entered into automatic recording devices only electronically and directly from the related weighing instrument.

(14) Size of Graduated Intervals or Increments

In any series of graduations, indications, or recorded representations, the values of the graduated intervals or increments shall be uniform throughout the series. (H-44, 1994, G-S.5.3.)

(15) Repeatability of Indications

A device shall be capable of repeating within prescribed tolerances its indications and recorded representations. This requirement shall be met

irrespective of repeated manipulation of any element of the device in a manner approximating normal usage (including displacement of the indicating elements to the full extent allowed by the construction of the device and repeated operation of a locking or relieving mechanism) and of the repeated performance of steps or operations that are embraced in the testing procedure. (H-44, 1994, G-S.5.4.)

(16) Recorded Representations

Insofar as they are appropriate, the requirements for indicating and recording elements shall be applicable also to recorded representations. All recorded values shall be printed digitally. (H-44, 1994, G-S.5.6.)

(17) Tape Printers

Tape printers on automatic-indicating scales shall be designed to produce a minimum of an original and one copy of the printed record.

(18) Ticket Printers

Ticket printers on automatic-indicating scales shall be designed to produce an original and five copies of the printed record. Ticket printers on nonautomatic-indicating scales shall be designed to produce an original and one copy of the printed record.

(19) Multiple Indications and Recorded Representations

All indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the device and shall agree with primary indications.

(20) Marking Operational Controls, Indications, and Features

All operational controls, indications, and features, including switches, lights, displays, pushbuttons, and other means shall be clearly and definitely identified. (H-44, 1994, G-S.6.)

(21) Gate Position

Provisions shall be made to clearly indicate to the operator the position of the gates leading directly to and from the weigh hopper. (H-44, 1994, S.3.1. ABWS Code)

(22) Interlocks

Each automatic bulk weighing system shall have operating interlocks to provide for the following:

(a) Product cannot be cycled and weighed if the weight recording element is disconnected or subjected to a power loss,

(b) The recording element cannot print a weight if either of the gates leading directly to or from the weigh hopper is open,

(c) A "low paper" sensor, when provided, is activated, and

(d) The system will operate only in the proper sequence in all modes of operation.

(e) When an overfill alarm is activated, the system shall indicate and record an overfill condition. (H-44, 1994, S.3.2. ABWS Code)

(23) Overfill Sensor

The weigh hopper shall be equipped with an overfill sensor which will cause the feed gate to close, activate an alarm, and inhibit weighing until the overfill condition has been corrected. (H-44, 1994, S.3.3. ABWS Code)

(24) Weighing Sequence

(a) For automatic bulk weighing systems used to receive (weigh in), the no-load reference value shall be determined and recorded only at the beginning of each weighing cycle. For automatic bulk weighing systems used to deliver (weigh out), the no-load reference value shall be determined and recorded only after the gross load reference value for each weighing cycle has been indicated and recorded. (H-44, 1994, S.1.4. ABWS Code)

(b) On a single draft manually operated receiving hopper scale installed below grade, used to receive grain, and utilizing a no-load reference value, provision shall be made to indicate and record the no-load reference value prior to the gross load value. (H-44, 1994, S.1.1.2.)

(25) Zero Indication for Automatic Bulk Weighing and Other Systems

Provisions shall be made to indicate and record a no-load reference value and if the no-load reference value is a zero indication, to indicate and record an out-of-balance condition on both sides of zero. (H-44, 1994, S.1.1., ABWS Code in part)

(26) Zero Indication - Digital Indicating Elements

(a) A digital zero indication shall represent a balance condition that is within ± ½ the value of the scale division.

(b) A digital indicating device shall either automatically maintain a "center-of-zero" condition to ±¼ scale division or less, or have an auxiliary or supplemental "center-of -zero" indicator that defines a zero-balance condition to ±¼ of a scale division or less. (H-44, 1994, S.1.1.1.)

[Nonretroactive as of January 1993]

(27) Length of Graduations

Graduations shall be so varied in length that they may be conveniently read. (H-44, 1994, S.1.3.1.)

(28) Width of Graduations

In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations and the width of main graduations shall be not more than 50 percent greater than the width of subordinate graduations. Graduations shall not be less than 0.008 inch

in width. (H-44, 1994, S.1.3.2.)

(29) Clear Space Between Graduations

The clear space between graduations shall be not less than 0.03 inch. If the graduations are not parallel, the measurement shall be made:

(a) Along the line of relative movement between the graduations and the end of the indicator, or

(b) If the indicator is continuous, at the point of widest separation of the graduations. (H-44, 1994, S.1.3.3.)

(30) Symmetry of Indicators

The index of an indicator shall be symmetrical with respect to the graduations with which it is associated and at least throughout that portion of its length that is associated with the graduations. (H-44, 1994, S.1.4.1.)

(31) Dial Indicator Length

The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 0.04 inch. (H-44, 1994, S.1.4.2.)

(32) Dial Indicator Width

The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

(a) The width of the widest graduation, and

(b) The width of the clear space between weight graduations.

(c) When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation. (H-44, 1994, S.1.4.3.)

(33) Dial Indicator Clearance

The clearance between the index of an indicator and the graduations shall in no case be more than 0.06 inch. (H-44, 1994, S.1.4.4.)

(34) Parallax

Parallax effects shall be reduced to the practicable minimum. (H-44, 1994, S.1.4.5.)

(35) Dial Weight Ranges and Unit Weights

The total value of weight ranges and of unit weights in effect or in place at any time shall automatically be accounted for on the reading face and on any recorded representation. (H-44, 1994, S.1.7.,in part)

d. Design of Balance, Tare, and Damping, and Arresting Mechanisms

(1) Zero-Load - General

The weighing system shall be equipped with manual or semiautomatic means by which the zero-load balance or no-load reference value indication may be adjusted. An automatic zero-setting mechanism is prohibited on hopper scales. (H-44, 1994, S.2.1. ABWS Code in part)

(2) Zero-Load Adjustment

(a) A manual zero-load or no-load reference value setting mechanism shall be operable or accessible only by a tool outside of or entirely separate from this mechanism or enclosed in a cabinet.

(b) A semiautomatic zero-load or no-load reference value setting mechanism (push-button zero) shall be operable only when:

1) For automatic bulk weighing systems

a) The indication is stable within ± 3 scale divisions, and

b) It cannot be operated during a weighing operation. (H-44, 1994, S.2.1.1., S.2.1.2 ABWS Code in part)

2) For other scales

a) The indication is stable within ± 3 scale divisions for scales of more than 5,000 pound capacity in service prior to January 1, 1981, and all railway track and vehicle scales, and

b) Plus or minus l scale division for all other scales. (H-44, 1994, S.2.1.2. in part)

3) Zero-Load Adjustment on Mechanical Scales

Any loose material used to adjust the zero-load balance on a mechanical scale shall be so enclosed that it cannot shift in position and alter the balance condition of the scale. A balance ball shall not itself be rotatable unless it is automatic in operation or is enclosed in a cabinet. (H-44, 1994, S.2.1.1., and S.2.1.2. in part)

4) Scales Equipped with an Automatic Zero-setting Mechanism

Under normal operating conditions the maximum load that can be "rezeroed" when all at once either placed on or removed from the platform shall be:

a) For vehicle and railway track scales ± 3.0 scale divisions, and

b) For all other scales except automatic bulk weighing scales ± 1 scale division. (H-44, 1994, S.2.1.3. in part)

5) Tare

On any scale, the value of the tare division shall be equal to the value of the scale division. The tare mechanism shall operate only in a backward direction (that is, in a direction of underregistration) with respect to the zero-load balance condition of the scale. On a device designed to automatically clear any tare value entered, means shall be provided to prevent the clearing of tare until a complete transaction has been indicated. (H-44, 1994, S.2.3. in part)

6) Balance Indicator

On a balance indicator consisting of two indicating edges, lines, or points, the ends of the indicators shall be sharply defined. When the scale is in balance, the ends shall be separated by not more than 0.04 inch. A mechanical grain-test scale shall be equipped with a balance indicator. If this consists of an indicator and a graduated scale that are not in the same plane, the clearance between the indicator and the graduations shall be not more than 0.04 inch. (H-44, 1994, S.2.2. and S.2.2.2. in part)

7) Damping Means

An automatic-indicating scale and a balance indicator shall be equipped with effective means to damp oscillations and to bring the indicating elements quickly to rest. (H-44, 1994, S.2.5.)

8) Motion Detection

Electronic indicating elements equipped with recording elements shall be equipped with effective means to permit the recording of weight values only when the indication is stable within:

a) Plus or minus 3 scale divisions for scales of more than 5,000 pounds capacity and for all vehicle and railway track scales.

b) Plus or minus l scale division for all other scales.

c) The values recorded shall be within applicable tolerances. (H-44, 1994, S.2.5.1.)

9) Motion Detection for Automatic Bulk Weighing Systems

Effective means shall be provided to permit the recording of weight values only when the indication is stable within ± 3 scale divisions for devices with 10,000 scale divisions, or ± l division for devices with less than 10,000 scale divisions. (H-44, 1994, S.2.2. ABWS Code in part)

10) Level-Indicating Means

A portable scale shall be equipped with level-indicating means if its weighing performance is changed by an amount greater than the appropriate acceptance tolerance when it is moved from a level position and rebalanced in a position that is out of level in any upright direction by 5 percent (approximately 3 degrees). The level-indicating means shall be readable without removing any scale parts requiring a tool. (H-44, 1994, S.2.4. in part)

e. Design of Weighing Elements

(1) Antifriction Means

Frictional effects shall be reduced to a minimum by suitable antifriction elements. Opposing surfaces and points shall be properly shaped, finished, and hardened. A platform scale having a frame around the platform shall be equipped with means to prevent interference between platform and frame. (H-44, 1994, S.4.1.)

(2) Adjustable Components.

An adjustable component such as a nose-iron, pendulum, spring, or potentiometer shall be held securely in adjustment and except for the

level-adjusting and zero-load balance mechanisms shall not be adjustable from the outside of the scale. The position of a nose-iron on a scale of more than 2,000-lb capacity, as determined by the factory adjustment, shall be accurately, clearly, and permanently defined. (H-44, 1994, S.4.2.)

(3) Multiple Load-Receiving Elements

A system with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load-receiving element (or elements) is in use. (H-44, 1994, S.4.3.)

(4) Accuracy Classes on Scales Manufactured After January 1, 1986

Scales are divided into accuracy classes and shall be designated as II, III, or III L. The accuracy class of scales is designated by the manufacturer and shall comply with parameters shown in the table in this section under "i. 5." (H-44, 1994, S.5.1., S.5.2. in part)

(5) Multi-Range Scales

On a variable division-value scale, the value of "e" shall be equal to the value of "d". (H-44, 1994, S.5.3.)

f. Design of Weighbeams and Poises

(1) Normal Balance Position

The normal balance position of the weighbeam of a beam scale shall be horizontal. (H-44, 1994, S.1.5.1.)

(2) Travel of Pans of Equal-Arm Scale

The travel between limiting stops of the pans of a nonautomatic-indicating

equal-arm scale not equipped with a balance indicator shall be not less than the minimum travel shown in Tables 1 and 2:

(H-44, 1994, S.3.1.)

Table 1 Minimum Travel of Pans of Nonautomatic Indicating Equal Arm Scale Without Balance Indicator

Nominal capacity (kilograms)	Minimum travel of pans (millimeters)
2 or less	9
2+ to 5 inclusive	13
5+ to 12, inclusive	19
Over 12	25

(3) Drainage

A load-receiving element intended to receive wet commodities shall be so constructed as to drain effectively. (H-44, 1994, S.3.2.)

(4) Travel

The weighbeam of a beam scale shall have equal travel above and below the horizontal. The total travel of the weighbeam of a beam scale in a trig loop or between other limiting stops near the weighbeam tip shall be not less than the minimum travel shown in table l. When such limiting stops are not provided, the total travel at the weighbeam tip shall be not less than 8 percent of the distance from the weighbeam fulcrum to the weighbeam tip. (H-44, 1994, S.1.5.2.)

Table 2 Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops

Distance from weighbeam fulcrum to limiting stops (inches)	Minimum travel between limiting stops (inch)
12 or less	0.4
12+ to 20, inclusive	0.5
20+ to 40, inclusive	0.7
Over 40	0.9

(5) Subdivision

A subdivided weighbeam bar shall be subdivided by scale division graduations, notches, or a combination of both. Graduations on a particular bar shall be of uniform width and perpendicular to the top edge of the bar. Notches on a particular bar shall be uniform in shape and dimensions, and perpendicular to the face of the bar. When a combination of graduations and notches is employed, the graduations shall be positioned, in relation to the notches, to indicate notch values clearly and accurately. (H-44, 1994, S.1.5.3.)

(6) Readability

A subdivided weighbeam bar shall be so subdivided and marked, and a weighbeam poise shall be so constructed, that the weight corresponding to any normal poise position can easily and accurately be read directly from the beam, whether or not provision is made for the optional recording of representations of weight. (H-44, 1994, S.1.5.4.)

(7) Poise Stop

Except on a steelyard with no zero graduation, a shoulder or stop shall be provided on each weighbeam bar to prevent a poise from traveling and remaining back of the zero graduation. (H-44, 1994, S.1.5.6.)

(8) Poises

No part of a poise shall be readily detachable. A locking screw shall be perpendicular to the longitudinal axis of the weighbeam and shall not be removable. Except on a steelyard with no zero graduation, a poise shall not be readily removable from a weighbeam. The knife edge of a hanging poise shall be hard and sharp and so constructed as to allow the poise to swing freely on the bearing surfaces in the weighbeam notches. (H-44, 1994, S.1.6.1.)

(9) Poise Adjusting Material

The adjusting material in a poise shall be securely enclosed and firmly fixed in position and if softer than brass, it shall not be in contact with the weighbeam. (H-44, 1994, S.1.6.2.)

(10) Poise Pawl

A poise, other than a hanging poise, on a notched weighbeam bar shall have a pawl that will seat the poise in a definite and correct position in any notch, wherever in the notch the pawl is placed, and hold it there firmly and without appreciable movement. The dimension of the tip of the pawl that is transverse to the longitudinal axis of the weighbeam shall be at least equal to the corresponding dimension of the notches. (H-44, 1994, S.1.6.3.)

(11) Reading Edge or Indicator

The reading edge or indicator of a poise shall be sharply defined, and a reading edge shall be parallel to the graduations on the weighbeam. (H-44, 1994, S.1.6.4.)

g. Marking Requirements [See also Section 3.3 b.(1), (9), c. (20)]

(1) Capacity and Value of the Scale Division for Automatic Bulk Weighing Scales

The capacity of the weighing system and the value of the scale division shall be clearly and conspicuously marked on the indicating element near the weight

value indications. (H-44, 1994, S.5.1. ABWS Code)

(2) Location Of Marking Information

Scales that are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in 3.3 b. (1) and Table 3 (following) located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these scales shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element or beneath the nearest access cover. (H-44. 1994, S.6.2.)

(3) Scales, Main Elements, and Components of Scales or Weighing Systems

Scales, main elements of scales when not contained in a single enclosure for the entire scale, load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program, and other equipment necessary to a weighing system, but having no metrological effect on the weighing system, shall be marked as specified in Table 3 and explained in the accompanying notes (Table 3 a).

(H-44, 1994, S.6.3.)

Table 3 Marking Requirements

Weighing Equipment To Be Marked With	Weighing, load-receiving, and indicating element in same housing	Indicating element not permanently attached to weighing and load-receiving element	Weighing and load-receiving element not permanently attached to indicating element	Load Cell with CC (11)	Other Equipment or Device (10)
Manufacturer's ID (1)	x	x	x	x	x
Model Designation (1)	x	x	x	x	x
Serial Number and Prefix (2)	x	x	x	x	x (16)
Accuracy Class (17)	x	x (8)	x (19)	x	
Nominal Capacity (3)	x	x	x		
Value of Scale Division(d) (3)	x	x			
Value of "e" (4)	x	x			
Temperature Limits (5)	x	x	x	x	
Concentrated Load Capacity (12)		x	x (9)		
Special Application (13)	x	x	x		
Maximum Number of Scale Divisions (n_{max}) (6)		x (8)	x (19)	x	
Minimum Verification Scale Division (e_{min})			x (19)		
"S" or "M" (7)				x	
Direction of Loading (15)				x	
Minimum Dead Load				x	
Maximum Capacity				x	
Safe Load Limit				x	
Load Cell Verification Interval (v_{min})				x	
Section Capacity (14)		x	x		

Table 4 Marking Requirement Notes

1. Manufacturer's identification and model designation. (H-44, 1994 G-S.1)

2. Serial number *[Nonretroactive as of January 1, 1968]* and prefix *[Nonretroactive as of January 1, 1968]* (H-44, 1994 G-S.1)

3. The nominal capacity and value of the scale division shall be shown together (e.g., 100,000 x 10 lb or 30 x 0.01 lb) adjacent to the weight display when the nominal capacity and value of the scale division are not immediately apparent. Each scale division value or weight unit shall be marked on variable-division value or division-unit scales.*[Nonretroactive as of January 1, 1983]*

4. Required only if different from "d." *[Nonretroactive as of January 1, 1968]*

5. Required only on class III and III L scales if the range is other than 14 EF to 104 EF (-10 to 40 EC).

6. This value may be stated on load cells in units of 1,000; e.g., n: 10 is 10,000 divisions.*[Nonretroactive 0 as of January 1, 1988]*

7. Denotes compliance for single or multiple load cell applications.

8. An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class of II, III, III L as appropriate, and the maximum number of scale divisions, n_{max}, for which the indicator complies with the applicable requirement. Indicating elements that qualify for use in both class III and III L applications may be marked III/III L and shall be marked with the maximum number of scale divisions for which the device complies with the applicable requirements for each accuracy class. *[Nonretroactive as of January 1, 1988]*

Notes for Table 4 (continued)

15. Required if the direction of loading the load cell is not obvious. *[Nonretroactive as of January 1, 1988]*

16. Serial number [as of January 1, 1968] and prefix [as of January 1, 1986]. (See G-S.1.) Modules without "intelligence" on a modular system (e.g., printer, keyboard module) are not required to have serial numbers.

17. The accuracy Class of a device shall be marked on the device with the appropriate designation as II, III, III L. *[Nonretroactive as of January 1, 1986]*

18. The nominal capacity shall be conspicuously marked as follows:

(a) on any scale equipped with unit weights or weight ranges;

(b) on any scale with which counterpoise or equal-arm weights are intended to used;

(c) on any automatic-indicating or recording scale so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent;

(d) on any scale with a nominal capacity less than the sum of the reading elements; and

(e) on the load-receiving element (weigh-bridge) of a vehicle.

[Nonretroactive as of January 1, 1989]

19. *[Nonretroactive as of January 1, 1988]*

(4) Railway Track Scales

A railway track scale shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Such marking shall be accurately and conspicuously presented on or adjacent to the identification or nomenclature plate that is attached to the indicating element of the scale. (H-44, 1994, S.6.4.)

(5) Weighing Elements

On a weighing element not permanently attached to an indicating element, there shall be clearly and permanently marked for the purposes of identification the name, initials, or trademark of the manufacturer, the manufacturer's designation that positively identifies the pattern or design, and the nominal capacity. (H-44, 1994, S.5.2., ABWS Code)

(6) Accuracy Class for Scales Manufactured After January 1, 1986

The accuracy class of a device shall be marked on the device with the appropriate designation as II, III, or III L. (H-44, 1994, S.5.1. in part)

(7) Temperature Limits for Scales Marked with an Accuracy Class for Class III and III L Devices

Unless the temperature range is -10 EC to + 40E (14E F to 104E F), the temperature range shall be marked on the device. (H-44, 1994, S.5.3. ABWS)

h. Installation Requirements

(1) Protection from Environmental Factors

The indicating elements, the lever system or load cells, the load-receiving element, and test weights shall be adequately protected from environmental factors such as wind, weather, and radio frequency interference that may adversely affect the operation or performance of the system. (H-44, 1994, UR.2.1. ABWS Code in part)

(2) Foundation, Supports, and Clearance

The foundation and supports of any system shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts so that no contact can result before or during operation of the system. On vehicle scales, the clearance between the load-receiving elements and the coping at the bottom edge of the platform shall be greater than at the top edge of the platform. (H-44, 1994, UR.2.2. ABWS Code in part)

(3) Access to Weighing Elements

Adequate provision shall be made for ready access to the pit of a vehicle or railroad track scale for purposes of inspection and maintenance. Any of these scales without a pit shall be installed with adequate means for inspection and maintenance of the weighing elements. Provisions shall be provided to lock or

securely seal all accesses to the pit. (H-44, 1994, UR.2.5. in part)

(4) Approaches to Vehicle Scales

On the entrance and exit ends of a vehicle scale installed in any one location for a period of 6 months or more, there shall be a straight approach as follows:

(a) At least the width of the platform.

(b) The length at least one-half the length of the platform but not required to be more than 12 m (40 ft), and

(c) Not less than 3 m (10 ft) of any approach adjacent to the platform shall be constructed of concrete or similar durable material to ensure that this portion remains smooth and level and in the same plane as the platform. However, grating of sufficient strength to withstand all loads equal to the concentrated load capacity of the scale may be installed in this portion. Any slope in the remaining portion of the approach shall insure: (1) ease of vehicle access; (2) ease for testing purposes; and (3) drainage away from the scale. (H-44, 1994, UR.2.6.1.)

(5) Hoists

On motor vehicle and railway track scales equipped with means for raising the load-receiving element from the weighing element for vehicle unloading, means shall be provided so that it is readily apparent to the weigher when the load-receiving element is in its designed weighing position. The printer shall not be operable until the load-receiving element is in its designed weighing position. (H-44, 1994, UR.2.8. in part)

i. User Requirements

(1) Balance Condition

The zero-load adjustment of a scale shall be maintained so that, with no load on the load-receiving element and with all load-counterbalancing elements of the scale such as poises, drop weights, or counterbalance weights set to zero, the scale shall indicate or record a zero-balance condition. A scale not equipped to indicate or record a zero-load balance shall be maintained in balance under any no-load condition. (H-44, 1994, UR.4.1.)

(2) Scale Modifications

The length, nor the width, nor the height of the load-receiving element of a scale shall be increased beyond the manufacturer's design dimension; nor shall the capacity of a scale be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity; nor shall any other modification be made, except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the scale and by FGIS. (H-44, 1994, UR.4.3. in part)

(3) Scale Division Selection Requirements for Official Automatic Bulk Weighing Systems

The number of scale divisions of a weighing system shall not be less than 4,000 or greater than 10,000 for a system with a capacity greater than 10,000 pounds and not less than 2,000 or greater than 10,000 for a system with a capacity equal to or less than 10,000 pounds.

(4) Grain Hopper Scales Division Selection Requirement

The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2,000. (H-44, 1994, UR.1.2.)

Table 5 Examples of Capacity and Scale Division

System capacity (Pounds)	Value of scale division (Pounds)	Number of scale divisions in system
20 000	2	10 000
20 000	5	4 000
20 000	10	2 000
40 000	5	8 000
40 000	10	4 000
60 000	10	6 000
100 000	10	10 000
100 000	20	5 000
120 000	20	6 000
200 000	20	6 000
200 000	50	4 000

(5) Scale Division Selection Requirements for Scales Marked With An Accuracy Class Other Than Automatic Bulk Weighing Scales

The accuracy class of a weighing device designated by the manufacturer and shall comply with the parameters shown in Table 6. (H-44, 1994, S.5.2.)

Table 6 Parameters for Accuracy Classes

Class	Value of the verification scale division (d or e[1])	Number of scale divisions (n)	
		Minimum	Maximum
SI Units			
II	1 to 50 mg, inclusive	100	100 000
	equal to or greater than 100 mg	5 000	100 000
III	0.1 to 2 g, inclusive	100	10 000
	equal to or greater than 5 g	500	10 000
III L[2]	equal to or greater than 2 kg	2 000	10 000
INCH-POUND			
III	0.0002 lb to 0.005 lb, inclusive	100	10 000
	0.005 oz to 0.125 oz, inclusive	100	10 000
	equal to or greater than 0.01 lb	500	10 000
	equal to or greater than 0.25 oz	500	10 000
III L[2]	equal to or greater than 5 lb	2 000	10 000

For Class II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape, or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means.
For Class III devices, the value of "e" is specified by the manufacturer as marked on the device; "e" must be less than or equal to "d."

The value of a scale division for crane and hopper (other than grain hopper) scales shall be not less than 0.5 lb (0.2 kg). The minimum number of scale divisions shall be not less than 1000.

(H-44, 1994, S.6.3.)

(6) Scale Division Selection Requirements for Scales Not Marked With an Accuracy Class Other Than Automatic Bulk Weighing Scales

Table 7 Applicable to Devices Not Marked with a Class Designation

Scale Type or Design	Maximum Value of d
Grain Hopper Scales Capacity up to and incl. 50 000 lb Capacity over 50 000 lb	10 pounds (but not greater than 0.05 % of capacity) 20 pounds
Vehicle Scales Capacity up to and including 200 000 lb Capacity over 200 000 lb	20 pounds 50 pounds
Railway Track Scales With weighbeam Automatic indicating	20 pounds 100 pounds
Scales with capacities greater than 500 lb except otherwise specified	0.1 % capacity (but not greater than 50 lb)

(7) Scale Division Selection Requirements for Grain Test Scales According To Application

Table 8 Scale Division Selection Requirements for Grain Test Scales According To Application

Application	Class	Max. Division Size
Scale used to weigh samples equal to or less than 120 g	II (Precision)	.01 g
Scales used to weigh moisture samples of 150 to 300 g	II or III (General)	.1 g
Scales used to weigh samples more than 120 g	II or III (General)	1 g mechanical .5 g electronic

(8) Value of Scale Division (d) and Weight Units

The value of the scale division expressed in a unit of weight shall be equal to 1, 2, or 5, or a decimal multiple or submultiple of 1, 2, or 5.

Examples: Scale division may be .01, .02, or .05; .1, .2, or .5; 1, 2, or 5; 10, 20, or 50. (H-44, 1994, S.1.2., S.1.1. in part)

(9) Split or Double Draft Static Weighing

A vehicle or a coupled vehicle combination or a railroad car shall be officially weighed statically on a vehicle or railway track scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination.

(a) The weight of a coupled combination may be determined by uncoupling the various elements (tractor, semi-trailer, trailer), statically weighing each unit separately as a single draft, and adding together the results, or

(b) The weight of a vehicle or coupled-vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform. (H-44, 1994, UR.3.3. in part)

(10) Supports

A scale that is portable and that is being used on a counter or table or on the floor shall be so positioned that it is firmly and securely supported. (H-44, 1994, UR.2.1.)

(11) Level Condition

If a scale is equipped with a level-condition indicator, the scale shall be maintained in level. (H-44, 1994, UR.4.2.)

(12) Railway Track Scales; Alignment of Dead and Weigh Rails

Dead rails should be provided for all scales where designed capacity doesnot correspond with the greatest combined load likely to run over scale rails. Weigh rails should be on the offset line and the dead rails should be straight unless a large portion of the cars is to be weighed.

(13) Standing of Equipment and Keeping Scales Under Load

Equipment shall not be allowed to stand on the platform of a vehicle or railway track scale except when being weighed and, in the case of hopper scales, grain shall not normally be retained on the weighing element for periods longer than a normal weighing cycle.

(14) Altering Poises and Counterpoise Weights

After a poise or counterpoise weight has been sealed, no material shall be added or removed without the approval of FGIS and an official test shall be conducted to recertify the scale.

(15) Hopper Scale Venting

All weighing systems shall be vented so that any internal or external pressure will not affect the accuracy or operation of the system. (H-44, 1994, S.4.4. ABWS Code)

(16) Minimum Test Weight Load for Automatic Bulk Weighing Scales

The minimum amount of certified test weight required for testing shall be 10% of scale capacity. (An increasing-load test using bulk material shall be conducted in increments not greater than the total value of the official test weights; the test shall be conducted to the official capacity of the weighing system.) (H-44, 1994, N.1. ABWS Code in part)

(17) Minimum Test Weight Load for Railway Track Scales

In the test of a railway track scale, the test weight load shall be not less than 80,000 pounds.

(18) Minimum Test Weights and Test Loads for Scales Other Than Automatic Bulk Weighing and Railway Track Scales

The minimum test weights and test loads for in-service tests are shown below.

Table 9 Minimum Test Weights and Test Loads			
Device capacity (pounds)	Minimums (in terms of device capacity)		Recommended** (where practicable)
	Test weights (greater of)	Test loads*	
0 to 100	105%		
101 to 1 000	50% or 100 lb	105%	
1 001 to 40 000	25% or 500 lbs	50%	Test weights to dial face capacity, 1000 d or test load to used capacity, if greater than minimums specified
40 000 +	12.5% or 10 000 lb	25%	

*The term "test load" means the sum of the combination of field standard test weights and any other applied load used in the conduct of a test using substitution or build-up test methods.

(H-44, 1994, N.3. in part)

(19) Assistance in Testing

If the design construction, or location of any scale is such as to require a testing procedure involving special equipment, accessories, or an abnormal amount of labor, the equipment, accessories, and labor shall be supplied by the owner or operator of the device. Test weights calibrated to service specifications shall be supplied by the scale owner or operator. (H-44, 1994, G-UR.4.4. in part)

(20) Minimum Loading Requirement for an Automatic Bulk Weighing Scale

A system shall not be used to weigh drafts less than 40 percent of the weighing capacity of the system except for a final partial draft. (H-44, 1994, UR.3.1. ABWS Code in part)

(21) Minimum Load for a Vehicle Scale

A vehicle scale shall not be used for weighing net loads smaller than 50 d. (H-44, 1994, UR.3.7.)

(22) Maximum Load

A scale shall not be used to weigh a load more than the nominal capacity of the scale. (H-44, 1994, U.R.3.2.)

j. Railway Track Scales; Additional Requirement Guidelines

(1) Rated Sectional Capacity

Table 10 Rated Capacity of Full Load Cell Scale

Sectional capacity (tons)	Each load-cell rated capacity (pounds)
Track scale:	
85	100 000
180	200 000

The rated sectional capacity of a full load cell scale should be one of those shown in Table 11 and shall employ load cells in capacities as shown.

The rated sectional capacity should be in no case exceed the actual sectional capacity. (Association of American Railroads, Engineering Division, Scale Handbook (AAR Handbook, 1996, 2.2.2.)

(2) Nose-Iron Guides

The guides for all noise-irons should be such that when one is moved for the purpose of adjustment, the pivot will be held parallel to its original position. The guide and ways of each cast iron lever should be machined. (AAR Handbook, 1996, 2.5.2)

(3) Leveling Lugs

In scales of the straight lever type, each lever should be provided with leveling lugs for longitudinal alignment. In scales of the torsion lever type, leveling lugs should be provided on the pipe or torsion member for transverse alignment and on the extension arm for longitudinal alignment. Each pair of lugs should be spaced 11 inches apart. The leveling surfaces of each pair of lugs should be finished to a common plane, which should be parallel to the plane through the knife-edges of the end pivots. (AAR Handbook, 1996, 2.5.3)

(4) Marking of Levers

Figures denoting the ratio of each lever should be cast or otherwise permanently marked on the lever. On a weighing element not permanently attached to an indicating element, there should be clearly and permanently marked for the purposes of identification, the name, initial, or the trade mark of the manufacturer's designation that positively identifies the pattern, or design, the nominal capacity, and the sectional capacity. (AAR Handbook, 1996, 2.5.5)

(5) Pivots and Bearings; Material

The material to be used for pivots and bearings should be alloy steel (SAE 52100), or a steel which will give equivalent performance, hardened to Rockwell C scale not less than 58 or more than 62. (AAR Handbook, 1996, 2.6.1)

(6) Design and Manufacture

Pivots should be so formed that the included angle of the sides forming the knife-edge will not exceed 90E and that the offset of the knife-edge from the center line of the pivot will not exceed 10 percent of the width of the pivot. (AAR Handbook, 1996, 2.6.2)

(7) Machined-in Pivots, When Required

For scales of greater sectional capacity than 50 tons, main lever pivots should be machine finished and fitted into machined ways. (AAR Handbook, 1996, 2.6.3 (b))

(8) Continuous Contact Required

Pivots should be mounted so that continuous contact of the knife-edges with their respective bearings for the full length of the parts designed to be in contact will be obtained; in loop bearings the knife-edges should project slightly beyond the bearings in the loops. (AAR Handbook, 1996, 2.6.3 (c))

(9) Position

In any lever the pivots should be mounted so that:

(a) Each knife-edge will be maintained in a horizontal plane under any load within the capacity of the scale;

(b) A plane bisecting the angle of a knife-edge of any lever will be perpendicular to the plane through the knife-edges of the end pivots;

(c) The actual distance between the end knife- edges of any lever will not differ from the nominal distance by more than 1/64 inch per foot; and

(d) The knife-edges in any lever will be parallel. (AAR Handbook, 1996, 2.6.4 (a)-(d))

(10) Support for Projecting Pivots

The reinforcement on the levers to support projecting pivots should be tapered off to prevent accumulation of dirt next to the pivots and to provide proper clearance. (AAR Handbook, 1996, 2.6.5)

(11) Design of Bearings

Bearing steels and the parts supporting or containing them should be so applied to the mechanism that permissible movement of the platform will not displace the line of contact between any bearing and the opposing pivot. (AAR Handbook, 1996, 2.6.7)

(12) Nose-Iron Design

Nose-irons should be constructed so that:

(a) They will be positioned by means of adjusting screws of standard size and thread;

(b) They will be retained in position by means of screws or bolts of standard size and thread; The surfaces of nose-irons intended to be in slidable contact with the levers will be machined true, so as to securely fit in or on the levers; and

(c) When adjustments are made, the knife-edge will be held parallel to its normal position. (AAR Handbook, 1996, 2.7.1 (a)-(d))

(13) Screws and Bolts

Adjusting and retaining screws and bolts should be made of a corrosion-resistant material. (AAR Handbook, 1996, 2.7.2)

(14) Retaining Device

A device for retaining each nose-iron in position should be provided and should be designed and constructed so that it will:

(a) Be independent of the means provided for adjustments;

(b) Not cause indentations in the lever;

(c) Not cause tension in the remaining bolts when loads are applied to the scale; and

(d) Cause the nose-iron to remain in position when the retaining device is released. (AAR Handbook, 1996, 2.7.3 (a)-(d))

(15) Loops and Connections; Material

The requirements for material and hardness of bearing surfaces in loop connections should be the same as those herein prescribed for pivots and bearings material. (AAR Handbook, 1996, 2.9.1 in part)

(16) Weighbeam Support

The weighbeam fulcrum stand and trig loop stand should be supported on a metal shelf mounted on metal pillars or material equivalent in strength and durability. The shelf should be sufficiently rigid that, within the capacity of the scale, deflection cannot occur to such an extent as will affect the weighing performance. (AAR Handbook 1991, 2.4.14)

(17) Weighbridge Girders

Weighbridge girders should be designed so that the joints over the centers of bearing will admit vertical flexure without deranging the sections. On short axle weighbridges no tipping of the weighbridges will be allowed. (AAR Handbook, 1996, 2.14.1)

(18) Weighbridge Bearings

The surfaces of weighbridge bearings intended to make contact with the bridge girders should be finished so that, when in position, all the bearing surfaces will be within 1/32 inch of the same horizontal plane and parallel to it. To secure proper alignment of parts, the diameters of the bolt holes in the weighbridge bearings and in the girders shall exceed the diameter of the bolts fastening the bearings to the girders by ½ inch. (AAR Handbook, 1996, 2.14.2)

(19) Stresses

To allow for impact and normal pit conditions, all steel design stress in scale weighbridges should be limited to 10,000 psi, and maximum deflection in main weighbridge beams or girders should not exceed 1/1200 of the span between sections. (AAR Handbook, 1996, 2.14.3 (b))

(20) Weigh Rails - Length and Weight

The weight and section of weigh rails should be as large as is consistent with surrounding yard track conditions, but no less than 115 pounds per yard. Rails should be one piece full length of scale. (AAR Handbook, 1996, 2.14.10 (a))

(21) Clearance Along Weigh Rails

The clearance between weigh rails or their pedestals and the rigid deck should be less than 1 ½ inches unless other adequate provision for clearance is made, and the openings should be protected from weather and foreign material. (AAR Handbook, 1996, 2.14.10 (c))

(22) Approach Rails

The approach rails should be in the same plane and alignment as the weigh rails and should be properly anchored to prevent creeping of approach rails to maintain the gap between the weighrails and the approach rails. Expansion rails are desirable whenever temperature extremes or mechanical displacement due to repeated loadings, as at humps, are anticipated. The gap should not be less than **c** inch nor exceed **e** inch unless special means are utilized to reduce impact from wheel loads passing from the approach rails to the weighrails. (AAR Handbook, 1996, 2.16.1)

(23) Miter Joints

For motion weighing scales, mitered joints should be provided. (AAR Handbook, 1996, 2.16.2)

(24) Clearance

The clearance between the bottom of any fixed beams, or deck supports, and the girder forming the weighbridge should not be less than 2 inches. (AAR Handbook, 1996, 2.18.3)

(25) Location

Scales should be so located that an adequate foundation and at least 75 feet of tangent track at each approach to the weigh rails can be provided. (AAR Handbook, 1996, 2.21.1 (a))

(26) Approach Walls Static Scales

Approach walls or piers of concrete should be built to extend at least 25 feet from the pit face of the end walls and back under the track to preserve line and surface of tracks. They may be built of a solid mass of concrete or may consist of parallel walls or piers; however, the latter construction should have a single footing supporting both walls. Where necessary to obtain safe bearing capacity, the approach walls should extend to the same depth as the pit walls. (AAR Handbook, 1996, 2.22.6 (a))

(27) Footings or Piers for Load Cells

Concrete footings or piers supporting load-cell base plates should not be less than 18 inches thick. Their tops shall be above the floor a sufficient distance to prevent the accumulation of water around or under the base plates. (AAR Handbook, 1996, 2.22.10 (b))

(28) Footings or Piers for Lever Stands

Concrete footings or piers supporting the lever stands should be not less than 18 inches thick. Their tops shall be above the floor a sufficient distance to prevent the accumulation of water under the base of the stand, and should be finished to an exact level and elevation to receive the lever stands directly without the use of shims or grouting where possible. If the scale is of a type having main levers or parts of the bearing assemblies that hang below the bases of the main lever stands, the piers should be provided with recesses of a size to give clearance of not less than 1.5 inches and should be formed so as to prevent accumulation of foreign matter. (AAR Handbook, 1996, 2.22.10 (a))

(29) Anchor Bolts

Anchor bolts for lever stands (minimum 2 each) or load cell base plates (minimum 4 each) should be embedded in the concrete foundation a minimum of ten inches and they should be provided with hooks, plates, or other

projection embedded at least eight inches below the finished concrete bearing surface. (AAR Handbook, 1996, 2.22.12)

(30) Bearing Pressures Under Foundations

The bearing areas of the foundation footings should be such that the pressure under the footings will not exceed:

(a) For fine sand and clay -- 4,000 lb. per sq. ft.

(b) For coarse sand and gravel or hard clay -- 6,000 lb. per sq. ft.

(c) For boulders or solid rock--20,000 lb. per sq. ft. If the soil does not have a bearing capacity of at least 4,000 pounds per sq. ft. and its bearing capacity cannot be increased by drainage, by stabilization, or by other means, pile foundations should be provided. Careful soil exploration, including bores, is always desirable. (AAR Handbook, 1996, 2.22.19)

3.4 TOLERANCES

a. General

The tolerances listed in this section shall be applied to all scales under the jurisdiction of the Service.

(1) Theory

It is understood that exact or errorless performance of weighing devices is unattainable. Uniform tolerances are therefore prescribed to allow permissible errors small enough to satisfy both buyer and seller and large enough so that both manufacturing and maintenance costs are not disproportionate. FGIS provides two sets of tolerances where necessary: "Acceptance" and "Maintenance" tolerances. Acceptance tolerances shall be applied to new installations and to installations where adjustments and/or modifications have taken place after official rejection or exceeding applicable tolerances. Maintenance tolerances provide an added range of "inaccuracy" (twice the value of acceptance tolerances) allowing for a limited amount of deterioration.

(2) Adjustments and Tolerances

When adjustments are made to scale systems they shall be made to bring the system as close to zero error as possible. Owners, operators, or repair persons shall not be allowed to adjust scale systems toward tolerance limits.

(3) Application and Uniformity

A weighing system may have errors in excess and/or deficiency. By application of "Approval Seals,"(FGIS-9601, Approved Label for Inspected Machinery) the scale official certifies that the weighing system is accurate and errors, if any, are within acceptable tolerance limits.

(4) Design

The tolerance for a weighing device is a performance requirement independent of the design principle used. (H-44, 1994, T.N.1.1.)

(5) Accuracy Classes

Weighing devices are divided into accuracy classes according to the number of scale divisions (n) and the value of each scale division (d). (H-44, 1994, T.N.1.2.)

(6) Scale Division

The tolerance of a weighing device is related to the scale division (d) or the value of the verification division (e) and is generally expressed in terms of d or e. (H-44, 1994, T.N.1.3.)

b. Tolerance Application

(1) General

The tolerance values are positive (+) and negative (-) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference; the tolerance values apply to certified test loads only. (H-44, 1994, T.N.2.1.)

(2) Multi-Range (Variable Division-Value) Scales

For multi-range devices, the tolerance values are based on the value of the scale division of the range in use. (H-44, 1994, T.N.2.4.)

c. Basic and Minimum Tolerance

(1) General

The basic tolerance includes both acceptance and maintenance tolerances. Where these tolerances provide an allowable error too small to be applicable, the minimum tolerance value shall apply. The minimum tolerance is the smallest allowable error that can be applied to any scale or weighing system.

(2) Minimum Tolerance for Scales That are not Under a Class Tolerance Application

When not otherwise specified the minimum tolerance to be applied shall be 0.05% (1/2000) of scale capacity or one-half "d" whichever is less. (H-44, 1994, T.1.1.3.)

(3) Minimum Tolerance for Automatic Bulk Weighing Scales

The minimum tolerance value shall not be less than half the value of the scale division. (H-44, 1994, T.2. ABWS Code)

(4) Tolerances for Scales not Marked with an Accuracy Class, Except for Automatic Bulk Weighing Scales, and Grain Test Scales

Paragraphs d. (4); e. (3) (a); e. (6) (a), (b), (c); and, e. (10) of this section also apply. (H-44, 1994, T.1.1. in part)

Table 11 Tolerances for Unmarked Scales

Type of Device	Subcategory	Min. Tol.	Accept Tol.	Maint. Tol.	Decreasing Load Multiplier[1]
Vehicle, railway track (weighing statically)		Maint. Tol. as shown in Table 13, Accept. Tol ½ values in Table 13.			1.0
All other scales	n > 5,000	0.5 d or 0.05% of scale capacity, whichever is less	0.05% of test load	0.1 % of test load	1.5
	n # 5,000	Maint. Tol. as shown in Table 13, Accept. Tol ½ values in Table 13.			1.0

[1]The decreasing load test applies only to automatic indicating scales.

(5) Tolerances for Grain Test Scales That are not Marked with an Accuracy Class According to Specific Use

Table 12 Tolerances for Unmarked Grain Test Scales				
Type	Usage	Tolerance	Sensitivity Requirement	Shift Tolerance
Precision	Samples less than equal to 120 g	.02 g	.01 g	.02 g
Moisture	Moisture portions from 150 g to 300 g	.2 g	.1 g	.2 g
General	Samples greater than 120 g other than moisture portions	1 g	1 g	1 g

(6) Tolerances for Scales Marked with an Accuracy Class, Except for Automatic Bulk Weighing Scales

(a) Maintenance Tolerances

Table 13 Tolerances for Scales Marked with an Accuracy Class

Maintenance Tolerances (All values in this table are in scale divisions)				
Tolerance in scale divisions				
	±1	±2	±3	±5
Class	Test Load			
II	0 - 5 000	5 001 - 20 000	20 001 +	
III	0 - 500	501 - 2 000	2 001 - 4 000	4 001 +
III L	0 - 500	501 - 1 000	(Add 1d for each additional 500d or fraction thereof)	

(H-44, 1994, T.N.3.1. in part)

(b) Acceptance Tolerance Values

The acceptance tolerance values shall be one-half the maintenance tolerance values. (H-44, 1994, T.N.3.2.)

(7) Tolerances for Automatic Bulk Weighing Scales

The basic maintenance tolerance shall be one pound per 1,000 pounds of test load (0.1 percent). The basic acceptance tolerance shall be one-half the basic maintenance tolerance. (H-44, 1994, T.3. ABWS Code, in part)

(8) Accumulated Error During Increasing Load Tests on Automatic Bulk Weighing Scales

The buildup test on electronic/levertronic hopper scales shall involve the substitution of material (grain) for known test weights in increments not to exceed the value of the test weights. At each step the error shall not exceed the applicable tolerance applied to the known test weights and the accumulated error shall not exceed the applicable tolerance applied to the total load (grain + test weights). The accumulated error shall be determined by the addition (algebraic sum) of individual step errors.

(9) Tolerances for All Vehicle and Railway Track Scales

The maintenance and acceptance tolerances shall be those for Class III L scales as listed in Item (6) (Table 13).

(H-44, 1994, T.N.3.1., T.N.3.2.)

d. Sensitivity and Discrimination Requirements

(1) Sensitivity Requirement (SR) for Nonautomatic-Indicating Scales not Marked with an Accuracy Class

(a) Application.

The sensitivity requirement (SR) is applicable to all nonautomatic-indicating scales not marked II, III, or III L, and is the same whether acceptance or maintenance tolerances apply. (H-44, 1994, T.2.1. in part)

(b) SR for Hopper Scales and Commodity Scales

2d, 0.2 percent of the scale capacity, or 40 pounds, which ever is least. (H-44, 1994, T.2.2. in part)

(c) SR for Grain Test Scales. 1d or 0.2 percent of the scale capacity, whichever is less. (H-44, 1994, T.2.6.)

(d) SR for Vehicle Scales.

1) Equipped with balance indicators - 1d.

2) Not equipped with balance indicators: 2d or 0.2 percent of the scale capacity, whichever is less. (H-44, 1994, T.2.7.)

(e) SR for Railway Track Scales

3d or 100 pounds, whichever is less. (H-44, 1994, T.2.8.)

(f) Sensitivity Requirements, Equilibrium Change Required

The minimum change shall be:

1) Scale with a Trig Loop but Without a Balance Indicator

The position of rest of the weighbeam shall change from the center of the trig loop to the top or bottom, as the case may be.

2) Scale With a Single Balance Indicator and Having a Nominal Capacity of Less Than 500 Pounds

The position of rest of a single indicator on a scale having a nominal capacity of less than 500 pounds shall change at least 0.04 inch or at least one division on the graduated scale, whichever is greater.

3) Scale With a Single Balance Indicator and Having a Nominal Capacity of 500 Pounds or Greater

The position of rest of a single indicator on a scale having a nominal capacity of 500 pounds or greater shall change at least

0.25 (¼) inch or one division on the graduated scale or

the width of the central target area, whichever is greater. However, the indicator on a batching scale shall change at least 0.125 (**c**) inch or one division on the graduated scale, whichever is greater.

4) Scale with Two Opposite-Moving Balance Indicators

The position of rest of the two indicators moving in opposite directions shall change 0.04 inch with respect to each other.

5) Scale with Neither a Trig Loop Nor a Balance Indicator

The position of rest of the weighbeam or lever system shall change from the horizontal, or midway between limiting stops, to either limit of motion.

(H-44, 1994, T.3. in part)

(2) Test Load for Nonautomatic-Indicating Scales Marked With an Accuracy Class

This subsection is applicable to nonautomatic-indicating scales marked II, III, or III L.

(a) The test load for sensitivity for nonautomatic-indicating vehicle scales shall be 1d for scales equipped with balance indicators, and 2d or 0.2 percent of the scale capacity, whichever is less, for scales not equipped with balance indicators.

(b) For all other nonautomatic-indicating scales, the test load for sensitivity shall be 1d at zero and 2d at maximum test load. (H-44, 1994, T.N.6.1. in part)

(3) Minimum Change of Indications for Nonautomatic-Indicating Scales Marked With an Accuracy Class

This subsection is applicable to nonautomatic-indicating scales marked II,

III, or III L. The addition or removal of the test load for sensitivity shall cause a minimum permanent change as follows.

(a) For a scale with trig loop but without a balance indicator, the position of the weighbeam shall change from the center to the outer limit of the trig loop.

(b) For a scale with a balance indicator, the position of the indicator shall change one division on the graduated scale, the width of the central target area, or the value as follows, whichever is greater.

1) Class II scale: 0.04 inch (1 mm).

2) Class III scale with a maximum capacity of 70 pounds (30 kg) or less: 0.08 inch (2 mm).

3) Class III or III L scales with a maximum capacity of more than 70 pounds (30 kg): 0.20 inch (5 mm).

(c) For a scale without a trig loop or balance indicator, the position of rest of the weighbeam or lever system shall change from the horizontal or midway between limiting stops to either limit of motion.

(H-44, 1994, T.N.6.2. in part)

(4) Discrimination Requirement for Digital Automatic-Indicating Weighing Scales

A test load equivalent to 1.4d shall cause a change in the indicated or recorded value of at least two divisions. This requires that the zone of uncertainty shall not be greater than 0.3 times the value of the scale division. (H-44, 1994, T.N.7.2.)

(5) Discrimination Requirement for Analog Automatic-Indicating Scales (i.e., Weighing Device with Dial, Drum, Fan, etc.)

A test load equivalent to 1.4d shall cause a change in the indication of at least 1.0d. (H-44, 1994, T.N.7.1. in part)

(6) Separate Main Element Requirement for Scales Marked with an Accuracy Class: Load Transmitting Element, Indicating Element, etc.

If a main element separate from a weighing device is submitted for type evaluation, the tolerance for the element is no more than 0.7 times that for the complete weighing device. This fraction includes the tolerance attributable to the testing devices used. (H-44, 1994, T.N.3.5.)

e. Tolerance Applications

(1) Acceptance Tolerance

Acceptance tolerances shall be applied as follows.

(a) To any equipment about to be put into official use for the first time.

(b) To equipment that has been placed in official service within the preceding 30 days and is being officially tested for the first time.

(c) To equipment that has been returned to official service following official rejection for failure to conform to performance requirements and is being officially tested for the first time within 30 days after corrective service.

(d) To equipment being officially tested for the first time within 30 days after major reconditioning or overhaul.

(e) To equipment undergoing type evaluation.

(H-44, 1994, G-T.1.)

(2) Maintenance Tolerance

Maintenance tolerances shall apply to equipment in actual use, except as provided for under "Acceptance Tolerance." (H-44, 1994, G-T.2. in part)

(3) Repeatability of Test Load Indications

(a) Static Conditions

The results obtained under reasonably static test conditions, by several weighings of the same load, shall agree within the absolute value of the maintenance tolerance for that load, and shall be within applicable tolerances. (H-44, 1994, T.N.5.)

(b) Zero-load Balance Change

A zero-load balance change test shall be conducted on all scales after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (H-44, 1994, N.1.9.)

(4) Excess and Deficiency

Tolerances "in excess" and tolerances "in deficiency" shall apply to errors in excess and to errors in deficiency, respectively. (H-44, 1994, G-T.3. in part)

(5) Scales That are not Marked With an Accuracy Class Involving Digital Indications or Representations

To the tolerances that would otherwise be applied, there shall be added an amount equal to one-half the minimum value that can be indicated or recorded. This does not apply to digital indications or recorded representations that have been corrected for rounding error using error weights. (H-44, 1994 T.1.1.2)

(6) Agreement of Indications

(a) Multiple Indicating/Recording Elements

In the case of a scale or weighing system equipped with more than one indicating element or indicating element and recording element combination, where the indicators or indicator/recorder combination are intended to be used independently of one another, tolerances shall be applied independently to each indicator or indicator/recorder combination. (H-44, 1994, T.N.4.1.)

(b) Single Indicating/Recording Element

In the case of a scale or weighing system with a single indicating element or an indicating/recording element combination, and equipped with component parts such as unit weights, weighbeam and weights, or multiple weighbeams that can be used in combination to indicate a weight, the difference in weight value indications of any load shall not be greater than the absolute value of the applicable tolerance for that load, and shall be within tolerance limits. (H-44, 1994, T.N.4.2.)

(c) Single Indicating Element/Multiple Indications

In the case of a analog indicating element equipped with two or more indicating means within the same element, the difference in weight indications for any load other than zero shall not be greater than one-half the value of the scale division (d) and be within tolerance limits. (H-44, 1994, T.N.4.3.)

(7) Time Dependence

At constant test conditions, the indication 20 seconds after the application of a load, and the indication after 1 hour shall not differ by more than:

(a) one half of the absolute value of the applicable tolerance for the applied load for class III L devices; and

(b) the absolute value of the applicable tolerance for the applied load for all other devices. (H-44, 1994, T.N.4.5.)

(8) Shift or Section Tests

The range of the results obtained during the conduct of a shift test or a section test shall not exceed the absolute value of the maintenance tolerance applicable and each test shall be within applicable tolerances. (H-44, 1994, T.N.4.4.)

(9) Ratio Tests

For ratio tests the tolerance values are .75 of the applicable tolerances. (H-44, 1994, T.N.2.5. in part)

(10) Railway Track Scales Weighing Uncoupled-in-Motion Cars

The basic maintenance and acceptance tolerance shall be the same as the static weighing basic tolerances for railway track scales.

f. Influence Factors

(1) Applicability

The following factors are applicable to tests conducted under controlled conditions only, provided that:

(a) Types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this section, and

(b) New types of devices submitted for approval after January 1, 1986, shall comply with the requirements of this section, and

(c) All devices manufactured after January 1, 1988, shall comply with the requirements of this section.

(H-44, 1994, T.N.8.)

(2) Temperature

Devices shall satisfy the tolerance requirements under the following temperature conditions.

(a) If not specified in the operating instructions for Class II scales, or if not marked on the device for Class III or III L scales, the temperature limits shall be:

14EF to 104EF (-10EC to 40EC)

(H-44, 1994, T.N.8.1.1)

(b) If temperature limits are specified for the device, the range shall be at least:

Temperature Range by Class	
Class	Temperature Range
II	27EF (15EC)
III, IIIL	54EF (30EC)

(H-44, 1994, T.N.8.1.2.)

(c) The zero-load indication shall not vary by more than 1 division per 9EF (5EC) change in temperature. (H-44, 1994, T.N.8.1.3.)

(d) Except for Class II devices, an indicating or recording element shall not display or record any usable values until the operating temperature necessary for accurate weighing and a stable zero balance condition has been attained. (H-44, 1994, T.N.8.1.4.)

(e) An indicating or recording element shall not display or record any usable values until the operating temperature necessary for accurate weighing and a stable zero balance condition has been attained. (H-44, 1994, T.5.)

(3) Electric Power Supply

(a) Power Supply, Voltage, and Frequency.

1) Weighing devices that operate using alternating current must perform within the established conditions inclusive over the line voltage range of 100 - l30 volts or 200-250 volts rms as appropriate and over the frequency range of 59.5 to 60.5 Hz.

2) Battery operated instruments shall not indicate or record values outside the applicable tolerance limits when battery power output is excessive or deficient. (H-44, 1994, T.N.8.3.1.)

(b) Power Interruption

A power interruption shall not cause an indicating or recording element to display or record any values outside the applicable tolerance limits. (H-44, 1994, T.N.8.3.2.)

(4) Barometric Pressure

The zero indication shall not vary by more than 1 scale division for a change in barometric pressure of 1 kilopascal over the total barometric pressure range of 95 to 105 kilopascals (28 to 3l inches of Hg.). (H-44, 1994, T.N.8.2. in part)

(5) RFI Susceptibility Tests, Field Evaluation

An RFI test shall be conducted at a given installation when the presence of RFI has been verified and characterized if those conditions are considered "usual and customary." (H-44, 1994, N.1.6.)

3.5 TEST PROCEDURES

a. General

(1) Scale Installation Requirements

Scale installations shall conform to the requirements in this chapter. Once a scale installation has been approved and has been tested for RFI, motion detection, and associated/nonassociated equipment interference, the scale may be tested for accuracy performance.

(2) Error and Tolerance Scale Accuracy Tests

Scale accuracy tests should be conducted according to the error testing method outlined in this section. The error testing method uses error (balance) weights to provide for error determination to two-tenths of a scale division. This method shall be used for the initial testing of new or modified installations. A second testing method, tolerance testing, may be used on electronic scales if circumstances, such as wind, make it impractical to use the error testing method.

(3) "As Found" Testing Requirements

Each scale shall be tested without adjustment to determine the "as found" condition and the results recorded on the test report. A printed weight record shall be made at each test load and compared with the scale indication. This printed record shall be attached to and filed with the original of the "Scale Test Report." (See section 3.1, d., (5), (d))

b. Pretest Examinations

(1) Purpose

This examination allows the authorized official to determine whether or not the design and construction of the scale conforms to the specifications and

requirements of FGIS. (2) Pretest Examination Steps

The following steps should be completed prior to performing a scale test.

(a) Determine whether the scale meets all the requirements as addressed in this chapter.

(b) Review the scale log and the previous test reports to familiarize yourself with the scale's history. Check the scale serial and seal numbers.

(c) Observe the scale indicator (beam movement or electronic display) for any obvious abnormalities.

(d) Perform any built-in checks; such as, span reference display, printer check, and display check.

(e) Inspect the load-receiving elements for potential problems; e.g., worn bearing, cracked load cell cable, check rod binds, dirty conditions, or inadequate clearance around scale parts.

(f) Check the test standards to ensure that they are currently certified and that the lifting apparatus will not interfere with the scale balance when the test weights are in the down position.

c. Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI) Test

This test is required for new or modified installations or whenever the scale official deems it necessary. This field test procedure applies to all electronic scales including analog and digital types. The test will determine whether or not the electronic scale equipment will perform satisfactorily while in the presence of EMI/RFI signals. EMI and RFI may originate from sources such as mobile communications equipment, commercial AM, FM, and TV broadcast transmitters. The result of such interference may cause weight indications to display inaccurately, printer devices to print erroneous

information, and data transmission or processing equipment to malfunction.

(1) Test Distances

At a distance not nearer than 1 meter to the equipment under test, and with the scale in a no-load condition and at any test load, operate the following equipment by alternately activating and deactivating the transmitter key under the specified conditions.

Table 14 Conditions for Testing RFI

Frequency	Field Strength	Modulation
26-MHZ 5-watt hand held communicator	Not to exceed 3 V/m	50% Amplitude, 1 kHz Sinewave
460-MHZ 4-watt hand-held	Not to exceed 3 V/m	50% Amplitude, 1 kHz Sinewave

(2) Allowed Variation

The variation of the weight indication with the disturbance compared with the weight indication without the disturbance shall not exceed one scale division (d) or the equipment shall:

(a) Blank the indication;

(b) Provide an error message; or,

(c) The indication shall be so completely unstable that it could not be interpreted, or transmitted into memory or to a recording element, as a correct measurement value. (H-44, 1994, T.N.9. in part)

d. Associated, Nonassociated Equipment Test

A weighing device shall meet all performance requirements when associated or nonassociated equipment is operated in its usual and customary manner and location.

This test is required for new or modified installations or whenever the scale official deems it necessary. (H-44, 1994, G-UR.3.2 in part) (1) Strain Test

During the test of the scale, apply a load equivalent to the normal weight applied to the scale and allow the scale to stabilize.

(2) EMI Test

Operate each electrical device, one at a time, if possible, in the vicinity of the scale and evaluate the scale performance. The following is a list of common devices that should be evaluated: lighting systems, office equipment, appliances, vending machines, stock handling equipment, elevators, hoists, relay switching equipment, motors, industrial controls, generators, brush type motors, electric tools, communications equipment, elevating legs, and belt conveyors.

(3) Source Interference Verification

If performance of the scale appears to be affected by any of the devices, the suspected interfering device should be turned on and off to verify it as the source of the problem. Note all findings on the test report.

(4) Scale Approval

Scales that fail to perform to the requirements of this section shall be rejected.

e. Motion Detection Test

(1) General

This test is required for new or modified installations or whenever the scale official deems it necessary. Electronic scales shall have motion detection capability which restricts printing of a weight value whenever the displayed weight is not stable within ± 1 division.

NOTE: The motion detection test shall be performed whenever a floating rig hopper scale is tested.

(2) Testing ProceduresPlace the scale in manual mode.

(a) Apply a test load, or in the case of hopper scales, fill the scale with an amount of grain equal to a normal draft amount.

(b) Allow the scale to stabilize.

(c) Physically move the load receiving element to produce approximately a 10 division weight fluctuation while the print button is depressed.

(d) Stop moving the load receiving element and keep the print button depressed until a weight is printed.

(e) The printed weight must be within ± 1 division from the original weight.

(f) Keeping the load on the scale, repeat several times starting with step (3).

f. Printer Tests

(1) General

Weight recording device(s) for electronic scales shall be tested, whenever deemed necessary, for accuracy in converting the displayed weight to a printed weight.

(2) Scales With a Built-in Printer Test

If the scale incorporates a built-in printer check, observe it in operation.

(3) Test Procedures for Scales Not Having a Built-in Printer Test

(a) Use zero adjustment to display and print all digits 0-9 in the tens, hundreds, and thousands columns as high as the adjustment will allow.

(b) In many electronic scales the zero adjustment only reaches to 2 or 3,000 pounds, after which the rest of the digits within the thousands, ten thousands, and hundred thousands pound columns can be displayed by filling the hopper with grain. This can be accomplished during the buildup test, or in the case of vehicle or track scales, several different test loads can be used to check the printer in higher ranges.

g. Sensitivity Tests

(1) General

A sensitivity test shall be conducted on nonautomatic-indicating scales only. The test shall be conducted with the weighing device in equilibrium at zero-load and at maximum test load by increasing or decreasing the test load in an amount equal to the applicable value indicated below. If the device is tested with a balance indicator, it shall only be operated with a balance indicator. If the device is tested without a balance indicator, it shall be operated without a balance indicator. (H-44, 1994, N.1.4., T.N.6., in part)

(2) Test Load Requirements

(a) The test load for sensitivity for nonautomatic-indicating vehicle scales shall be 1d equipped with balance indicators, and 2d or 0.2 percent of the scale capacity, whichever is less, for scales not equipped with balance indicators.

(b) For all nonautomatic-indicating scales, the test load for sensitivity shall be 1d at zero and 2d at maximum test load.

(c) The sensitivity requirement (SR) for all other scales is listed in the tolerance section of this chapter.

(3) Test Procedures

(a) Add to or remove from the load-receiving element error/balance weights in intervals equal to 0.2 the minimum division.

(b) Sensitivity is determined by the amount of weight needed to bring the weighbeam from a condition of equilibrium in the center of the trig loop to a stable condition at the bottom or top of the trig loop,

whichever the case may be. Record the actual sensitivity in pounds on the "Scale Test Report."

h. Discrimination Test for Electronic Scales

(1) General

A discrimination test shall be conducted on digital automatic-indicating scales with the weighing device in equilibrium at zero-load and at maximum test load and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. Electronic grain test scales require this test only during National Type Evaluation Program approval. (H-44, 1994, N.1.5., T.N.7. in part)

(2) Test Procedure

Conduct this test from just below the lower edge of the zone of uncertainty for increasing-load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests. Set the digital indication at the lower edge or just above the edge of the zone of uncertainty as follows. (H-44, 1994, N.1.5.1.)

(a) Set the digital indication to a stable indication using the tare adjustment or error/balance weights.

(b) Add error/balance weights in increments of 0.1d to the load-receiving element until the weight indication flashes to the next higher division.

(c) Remove 1d and the weight indication should be stable at the lower value. This is the leading edge of the zone of uncertainty.

(d) The indication can be set to just above the zone of uncertainty by adding error/balance weights until the flashing stops and the weight indication is stable at the next higher division. This point is established for use in decreasing-load tests.

(e) Add the equivalent of 1.4d to the load-receiving element. The weight indication shall change at least 2d from the starting value. (H-44, 1994, T.N.7.2. in part)

i. Weighbeam Test

(1) Fractional Poise Test Using Known Test Weights

This test should be performed when sufficient test standards are available to apply to the load-receiving element.

(a) Balance the beam at zero with error/balance weights equal to the minimum division applied to the load-receiving element.

(b) Apply test weights equal to approximately one-half and full capacity of the fractional poise to the load-receiving element.

(c) Move the fractional poise to the graduation equal to the test load applied and observe the beam for balance.

(d) To determine error, add or subtract error/balance weights until the beam balances, and record results on "Scale Test Report."

(e) The fractional poise indication must be within the applicable tolerance (minimum tolerance). Proper seating of the poise on the beam is a critical factor for the accuracy of beam operation.

(2) Fractional Poise Test Utilizing Butt Ratio Weight Kits (Optional)

This test eliminates indications of error that may be present in the lever system and uses the known weighbeam butt ratio.

(a) Balance the beam with the poise at zero and with a hanger pan connected to the beam rod or beam rod containing butt ratio weights equal to at least the minimum division.

(b) Determine the weighbeam nominal butt ratio by placing l pound on the beam rod hanger pan and bringing the beam to balance by moving the poise. The poise indication is the butt ratio.

(c) Apply butt ratio weights proportional to one-half and full capacity of the fractional poise (using the beam ratio).

(d) Determine equivalent error in poise by noting the discrepancy in poise indication and calculated indication.

(e) The fractional poise must be within applicable tolerance (minimum tolerance). Proper seating of the poise on the beam is a critical factor for the accuracy of beam operation.

(3) Ratio Test for Scales with CP Beams (Counter-poise Weighbeams)

A ratio test shall be conducted on scales employing counterpoise weights. Ratio tests determine if the actual system ratio between counterpoise weights and applied load meets specific tolerances with respect to the standard ratio for the weighing device (usually 1,000 to 1). (H-44, 1994, N.1.7. in part)

NOTE: The facility's counterpoise weights shall not be used in this test. As these counterpoise weights are required to conform to their own standards, any error in these weights would detract from the purpose of the ratio test. Standard slotted weights from the test weight kits shall be used to counterbalance the known test load applied. To adequately perform this test, a sufficient known test load (10% of scale capacity) must be available.

(a) Determine weighbeam tip ratio (e.g., 1,000 to 1).

(b) Apply error/balance weights to the load-receiving element equal to the tolerance of the known test load.

(c) Balance the beam with the poise set at zero and with no weight on the counterpoise stem.

(d) By using the ratio of the system, apply ratio weights to the counterpoise tip hanger equivalent to the applied load on the weigh hopper.

(e) Determine the actual error -- the amount of error/balance weights needed to be subtracted from or added to the load-receiving element to bring the beam to a balance condition.

j. Hopper Scale Buildup Test

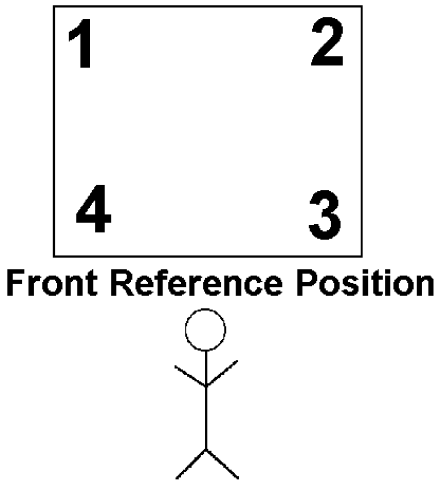
A buildup test using bulk material shall be conducted in increments not to exceed the total value of the official test weights; the test shall be conducted to the certified capacity of the weighing system. The applicable tolerance shall apply to the known test load at each step. (H-44, 1985, N.1.1. ABWS Code in part)

(1) Corner Test

A corner test shall be performed whenever possible before the buildup test begins. This test helps to indicate that no errors or binds exist in any of the levers or that load cell output is approximately the same from each load cell. The indication of each corner must be within ± 1 division.

(a) Balance the scale at zero load.

(b) Lift one-quarter of total test weight(s) (one corner).



(c) Record indicated or displayed weight value, repeat for each corner. Number the corners as indicated above.

(2) Mechanical Hopper Scales Test

(a) Apply error/balance weights to the load-receiving element equal to at least the applicable tolerance (usually one scale division.)

(b) Balance the scale (weigh hopper empty) at zero.

(c) Apply the known test load to the weigh hopper (at least 12.5% of scale capacity).

(d) Move poise to appropriate position on beam (position equal to the applied load).

(e) Determine error by the amount of error/balance weights added to or subtracted from the load-receiving element needed to bring the beam to balance.

(f) Record the test weight applied and error (print ticket).

(g) Remove test weights and record any zero balance change. (Balance should return to within the minimum applicable tolerance.)

(h) Add grain to weigh hopper not exceeding the amount of the test weight that had been previously applied and determine a balance reference point (using error/balance weight if needed).

(i) Add test weights, add or remove error/balance weights to balance beam and record error (print ticket). Continue the buildup test to the scale capacity.

(j) Upon the completion of the buildup test, the test weights should be removed from the device and the grain dumped from the hopper. All original error/balance weights shall be returned to the load-receiving element.

(k) Zero balance change shall be recorded after all grain and test weights are removed from the scale and can be determined by adding or removing error/balance weights. Zero balance shall not change more than the applicable tolerance. If zero balance change is out of tolerance, empty the scale, reload the scale with grain, empty and check the balance change again.

(l) The weighbeam shall be returned to a zero balance condition before being put into official weighing operation.

(3) Levertronic or Full Electronic Hopper Scale Test

(a) Error Test Method

This procedure shall be used for initial tests on new installations or whenever the scale official deems it necessary. To minimize misinterpretation of displayed weight representations and to increase the accuracy of test data, the test shall be conducted from the leading edge of the zone of uncertainty.

1) Apply error/balance weights to the load-receiving element equal in amount to the minimum division.

2) Apply error/balance weights in intervals equal to 0.2 the minimum division to the load-receiving element until the indicator just begins to flash between the zero-balance weight and the next division. Record on Scale Test Report the total amount of pounds of error/balance weights on the load-receiving element.

3) Apply the known test weights to the load-receiving element and observe the indicated weight.

4) Add to or subtract from the load-receiving element error/balance weights until the indicator displays the appropriate weight. (Example: zero reference 0/10 when

10,000 pounds applied, indicator should read 10,000/10,010.) Record the total amount of error weights on the load-receiving element.

5) Error shall be determined by the amount of error/balance weights added to or subtracted from the load- receiving element to achieve the desired or correct reading. Record error.

6) Remove test weights. Return original amount error/balance weights and record zero balance.

7) Continue alternately filling with grain and applying test load until scale is tested to capacity.

8) Remove test weights and empty the hopper. Check and record zero balance with respect to original error/balance weights.

9) The applicable tolerance shall apply only to the known test load at each step.

(b) Tolerance Test Method

The buildup test on electronic/levertronic hopper scales shall involve the substitution of material (grain) for known test weights.

1) Record the no load indication in the grain column of the "Scale Test Report."

2) Apply test weights and observe indication. Record on the Scale Test Report both test weights applied and indication under the test weight column and scale indication column respectively.

3) When recording weight indications during a tolerance test, the

indication may be at the breakpoint between two indications, which frequently causes the indication to change by 1 division. If this is the case, record both weight indications; e.g., 10,000/10 under the appropriate column.

4) Determine error by the difference between actual indication and the computed correct indication. Record error under the error column on the "Scale Test Report." Error derived from a changing weight indication shall be recorded as one-half a division.

5) At each step the error shall not exceed the applicable tolerance applied to the known test weights and the accumulated error shall not exceed the applicable tolerance applied to the total load (grain + test weights).

6) The accumulated error shall be determined by the addition (algebraic sum) of individual step errors. Add to the tolerance would otherwise apply (individual lifts and accumulated load) an amount equal to one-half the minimum value that can be indicated or recorded.

7) Remove test weights, record zero balance, and add grain to the hopper not exceeding the previous test point. Record indication under the grain column on the "Scale Test Report."

8) Apply test weights. Observe indication and determine error. Record test weights applied, indication, and error in the appropriate Scale Test Report columns. Check accumulated error, if any.

9) Continue alternately filling with grain and applying test weights until the scale is tested to capacity.

10) When scale is tested to capacity, discharge grain, remove test weights, check zero balance, and record on the bottom right-hand corner of the "Scale Test Report."

k. Associated Tests for Hopper Scales

(1) Associated Test for Venting

The effects of air pressure or vacuum on a scale can create erroneous weight representations on the indicating element. The following checks are examples of the type testing that should be used to evaluate venting. Special situations may dictate additional evaluation on the part of the scale official.

(a) Testing Under Static or Dynamic Conditions

1) Bring the indicating element to an exact balance condition.

2) With the upper garner empty, open the upper garner gate and observe any change in the balance indication.

3) With the upper garner empty, open the weigh hopper gate and observe any change in the balance condition. Repeat with the upper garner full.

4) Repeat step (3) with turn heads and spouting located in various positions to simulate normal operation.

5) Indication changes of ± 1 division are acceptable. Larger variations should be investigated and the cause documented on the "Scale Test Report."

(b) Testing While Weighing Grain

Make the following checks and observations during normal weighing operations.

1) Check for agreement between displayed and recorded weight value. As soon as the weight is printed and prior to the opening of the weigh hopper gates, press the "stop" or "hold" button or

function that will stop the automatic cycle. The printed weight should then be compared to the displayed weight.

2) Check for agreement within ± 1 division between the displayed weight and recorded weight value at the time the tare weight is printed.

3) Observe tare weights printed during a series of drafts. Tare weights should be within plus or minus 1 division of each other. However, a slow change in recorded tare weight is acceptable if it is caused by buildup of grain on the scale or by long-term drift due to temperature changes.

(2) The Effects of Hysteresis and Creep Encountered During Testing Of Electronic/Levertronic Scales

Hysteresis and creep, if encountered during testing of grain hopper scales, shall be recorded on the "Scale Test Report."

(3) Time Dependence Requirements for Scales Manufactured After January 1, 1987

At constant test conditions, the indication 20 seconds after the application of a load and the indication after 1 hour shall not differ by more than the absolute value of the applicable tolerance for the applied load. (H-44, 1994, T.4. ABWS Code)

(4) Determination of Allowable Time for Retention of Grain in a Weigh Hopper, For Scales Installed Prior to January 1, 1987

Except for emergencies, trimming a load, and cleaning out of a carrier, grain shall not be retained in the scale hopper beyond the normal operating cycle time. An operational time limit for the length of time a scale can remain under load can be determined by the scale official using the following method.

(a) Establish the time limit for performing this test, which is the maximum amount of time that grain would be retained in the hopper (example: 2 hours).

(b) Carefully set zero balance to ensure a good starting reference point.

(c) Fill the scale to the normal operating weight range and record the indicated weight.

(d) Record the indicated weight value every ½ hour until total time limit is reached (example: ½ hour, 1 hour, 1 ½ hours, 2 hours, etc.).

(e) Discharge all grain and make sure the scale is empty.

(f) Record empty weight of the scale.

(g) If the total amount of weight change between the first and last recorded weights of the full scale does not exceed the allowable error at that weight (1 pound per thousand) and the scale returns to zero balance within plus or minus 1 division, the scale is approved to hold a load for up to the tested time limit (in this example: 2 hours).

NOTE: During operation it is important that the gross weight be printed immediately after filling for the most accurate weight.

(5) Floating Rig List Test

The list test shall be performed as a part of new or modified installation certification requirements for floating rigs.

(a) Ensure that an inclinometer readable in at least ½ degree intervals is mounted perpendicular to the longitudinal axis of the boat, ship, or barge and within easy reading distance of the weight indicating element. The use of this instrument in testing the scale sets parameters for the maximum degree of list allowed during official weight certification.

(b) Utilizing the inclinometer the rig shall be brought to a zero list and a buildup test to scale capacity performed.

(c) The weigh hopper shall be filled to a normal draft size.

(d) The rig operator shall list the rig to ½ degree by whatever means available. When ½ degree list is reached, the reference weight shall be observed.

(e) This sequence shall continue at ½ degree intervals until the observed reference weight changes more than the applicable tolerance applied to that load and the rig cannot list any further.

(f) The maximum degree of list determined during the performance of this test will set the parameters allowable during official weighing; i.e., if the scale is found to be outside the allowable tolerance limits at 2 ½E list, no official weight shall be allowed when the scale exceeds 2E list.

(6) Floating Rig Dynamic Test

To simulate actual loading conditions and the effect of motion on the accuracy of the scale system, a dynamic test shall be conducted. The test shall be performed as part of the initial new or modified installation approval procedure.

(a) Fill the scale to a normal draft size. Approximately three-quarters of scale capacity.

(b) Record the digital indication. This is the reference weight.

(c) Calculate the number of prints to be recorded by dividing 50,000 bushels (or 2,800,000 pounds in the case of corn) by the reference weight and multiplying by 2.

(d) Determine print cycle time by dividing the normal draft cycle time by two. Normal draft cycle time is the time it takes the scale in normal operation to fill, print gross, discharge, and print tare.

(e) The print cycle time shall be the time between the previous printed weight data and the initiation of the next print cycle (i.e., depressing a print button). Due to effects of motion and settling time, there is a lapse between the actual initiation of a print cycle and the recording of the displayed weight.

(f) Cover the weight display to prevent biased test results.

(g) The rig operator shall begin simulating motion by using appropriate unloading mechanisms. If the rig is equipped with cranes, they will be required to swing a load approaching normal loading operations. This can be simulated by using the crane which will "scoop" water from the river, bay, etc. Discharge the water with the crane boom positioned at either end (bow or stern) of the rig.

(h) Initiate first print and wait until a weight is recorded.

(i) Pause for print cycle time and then initiate next print.

(j) Continue this print time sequence until the predetermined number of prints has been recorded. (Observe tapes for inaccurate weight representations.)

(k) Total the tape.

(l) Since interlocking mechanisms only allow a plus or minus printing sequence, totaling the tape at the end of the test will provide a total which represents an algebraic summation of all the weight deviations caused by rig motion. (The application of this test will ensure that mechanical favoritism towards either over or underregistration is not occurring.)

(m) The total amount of error (tape total) incurred during dynamic testing shall not exceed 0.1 percent of the total simulated load. This is determined by multiplying the static reference load by the number of "drafts" simulated. For example: Reference load prior to dynamic testing on a 5-pound division scale is 15,000 pounds. To simulate 2,800,000 pounds, 187 drafts are needed.

187 x 15,000 = 2,805,000 x .1% = 2,805 pounds

Scale error shall not exceed 2,805 pounds.

l. Vehicle Scale Test

The following outlines are excerpted from NCWM Publication 12, Examination Procedure Nos. 13, and 13 E dated, December 1991. Follow these outlines when testing vehicle scales: Use the outline following item (1) for scales equipped with weighbeams and/or mechanical dials; use the outline following

item (2) when the scales are equipped with electronic digital indicators.

SAFETY NOTES

The inspector is reminded of the importance of evaluating potential safety hazards prior to an inspection and taking adequate precautions to avoid personal injury or damage to the device. The inspector should read and be familiar with the introductory section of Section 3.7 of this Chapter. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" in Section 3.7.

Many policies and regulations will vary from jurisdiction to jurisdiction. It is essential that the inspector or serviceperson be aware of all safety regulations and policies in place at the inspection site and practice the safety policies established by the inspector's or serviceperson's employer. The safety reminders included in this EPO contain general guidelines for safety. These guidelines are useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injuries. These guidelines can only be effective in mitigating safety hazards if inspectors and servicepersons receive training in hazard recognition and controls.

- # Clothing
- # First Aid Kit
- # Lifting
- # Electrical Hazards
- # Support -- for scale, test weights, and test equipment
- # Safety Cones/Warning Signs
- # Transportation of Equipment
- # Location
  - also: Wet/Slick Conditions
    Chemicals, Petroleum Products, and Hazardous Materials
    Overhead Hazards
    Obstructions
- # Personal Protection Equipment
  - e.g. Safety Shoes
    Hard Hat -- for protection from overhead hazards

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions

Learn the nature of hazardous products used at or near the inspection site

Use caution in moving in wet, slippery areas

Use personal protection equipment appropriate for the inspection site

Position safety cones and warning signs if necessary

Be sure a first aid kit is available and that the kit is appropriate for the type of inspection activity

(1) Weighbeams and Dial Vehicle Scales

Examination Procedure Outline for Vehicle Scales Mechanical - Analog Indicating (Weighbeams and Dials)

Follow this outline for vehicle scales equipped with weighbeams and/or mechanical dials. Requirements that apply only to scales marked with an accuracy class are indicated with an asterisk. Nonretroactive requirements are followed by the applicable date in parentheses.

	H-44 General Code and Scales Code References
1. Zero-load balance as found. If the device is not in balance, the user should be made aware of paragraph UR.4.1.and a warning issued if necessary.	S.1.1., S.2.1.1., S.2.1.2., S.1.5.1., UR.4.1.
2. Marking	
Indicating and recording elements	G-S.1., G-S.6. (1/1/77), G-S.7.,G-UR.2.1.1., S.6.1. (1/1/89), S.6.3.
Weighing and load-receiving elements	S.6.1. (1/1/89), S.6.2., S.6.3.
3. Indicating and recording elements.	
Scale division, value (d) and number (n)	S.1.2.*, S.5.*, UR.1., UR.1.1.(b)
Tare division value	S.2.3. (1/1/83)
Tare mechanism	S.2.3.

Appropriateness of design	
General	1G-S.5.
Weighbeams	S.1.5. except S.1.5.5.
Poises	S.1.6.
Dials and balance indicators	S.1.3., S.1.4., S.1.7.
Damping means	S.2.5.
Suitability	S.5.2. (1/1/86)*, UR.1.1.(a)*, UR.3.1.*, UR.3.2., UR.3.3.
Customer readability, if applicable	G-UR.3.3.
Adjustable components	S.1.10.
4. Weighing and load-receiving elements	S.4., UR.2.8.
Access	UR.2.5.
5. Installation	G-UR.2., UR.2.3., UR.2.4.

Check to be sure the scale supports are adequate to support the scale, test equipment, and test weights equal to the capacity of the scale!

6. Approaches	
Vehicle scales	UR.2.6.1. (1/1/76)
Axle-load scales	UR.2.6.2.
7. Maintenance, use, and environmental factors	G-S.2., G-UR.1.2., G-UR.3.1., G-UR.4.,UR.3.2., UR.3.3., UR.3.7., UR.3.8., UR.4.3.
8. Assistance	G-UR.4.4.

Pretest Determinations:

1. Tolerances	
Acceptance/maintenance	G-T.1., G-T.2.
Application	T.N.2.1., T.N.2.3.

Tolerances values:

Scales marked with an accuracy class	T.N.3.1./Table 6 (Class III L),T.N.3.2., T.N.4. (except T.N.4.5.), T.N.5.
Scales not marked with an accuracy class	T.1.1., T.N.3.1./Table 6 (Class III L), T.N.3.2., T.N.4. (except T.N.4.5.), T.N.5.
Discrimination	T.N.7.1.*

Sensitivity:

Scales marked . .	T.N.6.1.(a), T.N.6.2.
Scales not marked	T.2.1., T.2.7.

2. Determine maximum test load to be applied during test: a test load not to exceed marked concentrated load capacity (or for scales manufactured prior to January 1, 1989, the marked Section Capacity) may be applied to any section or between any two sections. A test load of 100 percent of capacity may be distributed over the entire platform.

3. Minimum test weights and test loads — N.3.

Carefully inspect electrical supply lines for test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

Test notes:

Wear appropriate personal protection equipment such as safety shoes to prevent possible injury from falling weights and slipping on slick surfaces and a hard hat to prevent injury from overhead hazards

1. If beam scale, balance small error weights on the platform, the smallest weight equal to the minimum tolerance value and the total value of the weights being equal to the tolerance value at maximum test load.	
2. Check repeatability of, and agreement between, indications throughout the test	T.N.5., G-S.5.2.2.(b)
3. Recheck zero-load balance each time test load is removed	N.1.9., G-UR.4.2.
4. If the scale is equipped with a type-registering (T.R.) beam or a printer, print ticket at each test load.	G-S.5.6., UR.1.3.(1/1/86)*, G-S.5.2.2.(b)

Test:

Wear Safety Shoes! Use Proper Lifting Techniques

1. Sensitivity test at zero load (for weighbeams and balance indicators only)	N.1.4.
Discrimination (dials and balance indicators with graduations having a specific value only)	N.1.5. (1/1/86)*
2. Increasing-load and shift (section) test	N.1.1.

a. If beam scale, test at not less than two points on each weighbeam. Scales not equipped with a full capacity beam should be ratio tested using standard weights on counterpoise hanger. At each test load, test scale counterpoise weights by substituting them for the standard counter poise weights. If there is any noticeable change in the indication, remove the counter-poise weights from service until it can be determined it meets the re-quirements in the Weights Codes of H-44. When ratio testing, test poise and beam by substituting poise position with the removal of standard weights from counterpoise hanger.	N.1.7.
b. If automatic-indicating scale, test at not less than three points on reading face, including all possible quarters of the reading-face capacity. Test all unit weights possible.	
c. When performing a shift test, use not less than two different loads successively distributed any where on the load-receiving element using the prescribed test patterns and maximum test loads specified below.	N.1.3.4.

Test pattern: An area at least 4 feet long and a width equal to the width of the scale platform. When loading the scale for testing, one side of the test pattern shall be loaded to no more than one quarter of the concentrated load capacity before loading the other side.

Multiple pattern loading: To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

Other designs: Special design scales and those that are wider than 12 feet shall be tested in a manner consistent with the method of use, but following the principles described above.

Test load: The maximum test load applied to the prescribed test pattern shall not exceed the concentrated load capacity (or for scales manufactured prior to January 1, 1989, the rated section capacity).

Note: When testing scales manufactured prior to January 1, 1989, caution should be exercised when loading test weights equivalent to the rated section capacity onto areas between sections.

Note: When loading the first section to be tested, it is recommended observations be made at each increment of test weight application.

3. Decreasing-load test (dials only), at one-half of maximum test load (at no less than one-half dial face capacity)	N.1.2., N.1.2.2.
4. Strain-load test on at least two sections apply tolerance to test weight load only.	N.1.1.
5. Sensitivity test at maximum test load (weighbeams and balance indicators only)	N.1.4.
Discrimination (dials and balance indicators with graduations having a specific value only)	N.1.5. (1/1/86)*

6. Counterpoise-weight test, if device is so equipped	H-44 Weights Code
7. Remove test load and determine any zero-load balance change	N.1.9., G-UR.4.2.
8. Remove error weights and establish correct zero-load balance.	

(2) Electronic Vehicle Scales

Examination Procedure Outline for Vehicle Scales Equipped with Electronic Digital Indicators

	H-44 General Code and Scales Code References
Inspection:	
1. Zero-load balance as found. If the device is not in balance, the user should he made aware of paragraph UR.4.1. and a warning issued if necessary	G-S.5.2.2.(d) (1/1/86)*, S.1.1., S.2.1.1., S.2.1.2., UR.4.1.
2. Marking	
Indicating element:	G-S.1., S.6.3.
Manufacturer's name or ID	Retroactive
Model designation	Retroactive
Serial number	(1/1/68)
Serial number prefaced by term "Serial Number" or "S/N"	(1/1/86)
Accuracy class (may he marked with dual accuracy classes (e.g.,III/III L)	(1/1/88)
Nominal capacity	Retroactive

Shall not exceed the Concentrated Load Capacity (CLC) times the quantity of the number of sections in the scale minus 0.5	S.6.1. (1/1/89)
Value of the scale division shall he marked along with the nominal capacity	(1/1/83)
Temperature limits if other than -10 to 40^0C (14 to 104^0F)	(1/1/86)
Concentrated Load (or Section) Capacity	(1/1/89)
Maximum number of scale divisions (n_{max}) for which the scale has been approved	(1/1/88)
Other	G-S.6. (1/1/77), G-S.7., G-UR.2.1.1.
Weighing/load-receiving elements:	S.6.2., S.6.3.
Markings must he added to load-receiving element at the time of modification to any scale not previously marked	(1/1/89)
Manufacturer's name or ID	Retroactive
Model designation	Retroactive
Serial number	(1/1/68)
Serial number prefix	(1/1/86)
Accuracy class	(1/1/86)
Nominal capacity	Retroactive
Concentrated Load Capacity (CLC) (or Section Capacity for scales manufactured prior to 1989)	(1/1/89)
Minimum verification scale division for which device complies with the requirements (e_{min} or d)	(1/1/89)
Load cells with NTEP Certificates of Conformance	S.6.3.

Note: Required information may he on the data plate attached to load cell OR may be in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document (1/1/88). Manufacturer's name or trademark, model designation, and serial number prefix shall also he marked both on load cell and in any accompanying document (1/1/91).	(1/1/88)
Accuracy class	
Maximum number of divisions (in units of 1,000) for which accuracy class requirements are met	(1/1/88)
"S"' or "M" for single or multiple cell applications in conjunction with n_{max} for each accuracy class and application	(1/1/88)
Direction of loading if not obvious	(1/1/88)
Temperature limits if other than -10 to 40^0C (14 to 104^0F)	(1/1/88)
Name and address of manufacturer, model designation, minimum dead load, maximum capacity, safe load limit, and load cell verification interval, v_{min}	(1/1/88)
Other equipment	S.6.3.

3. Determination of Load Cell Suitability (applicable to load cells with an NTEP Certificate of Conformance):

a. The number of scale divisions (n) of the scale is less than or equal to the n_{max} of the indicator or the load cells, whichever is less; e.g., if the indicator has an n_{max} of 10,000 and the load cells have an n_{max} of 5,000, then the scale may use up to 5,000 divisions.

b. The load cell is approved for the required accuracy class. **Note**: A Class III load cell may be used in a Class III L application; however, the opposite is not true.

c. The load cell is rated Single (S) or Multiple (M) use as appropriate to the application.

Note: A load cell rated for single use may be used in a single or multiple load cell application; however, a load cell rated for multiple usecannot he used in a single load cell application.

d. The load cell complies with the requirements for temperature effect on zero-load balance

T.N.8.1.3., and the table at the end of this seciton, titled, “Maximum Values of Multiple Load Cell Scales”

Note: Testing to determine the effect of temperature on zero-load balance cannot he performed in the field; however, for purposes of field inspection, a load cell is considered to comply with T.N.8.1.3. if the v_{min} value marked on the load cell is less than or equal to the v_{min} value as calculated below based upon the d and N for the scale; if it is not, the scale does not comply with T.N.8.1.3.(See also 1988 OWM paper on "Device Regulation Under the New Scales Code.")

Full electronic scale with more than one load cell: The verification scale division, v_{min}, for the load cells must he less than or equal to the scale division, d, divided by the square root of the number of load cells, N, used in the scale:

$$v_{min} \# \frac{d}{\sqrt{n}}$$

Note: Maximum values of v_{min} for commonly encountered multiple load cell scales are listed in the Appendix to EPO 13-E.

For mechanical lever svstems with a single load cell:

$$v_{min} \# \frac{d}{\text{scale multiple}}$$

4. Indicating and recording elements. Scale division, value (d) and number (n)	S.1.2.*, S.1.2.1. (1/1/89), S.5.*, UR.1.,UR.1.1.(b)
Rounding	G-S.5.2.2.(c)
Tare division value	S.2.3. (1/1/83)
Tare mechanism	S.2.3.
Damping means	S.2.5., S.2.5.1.(a)
Appropriateness of design	G-S.5.
Suitability	S.5.2. (1/1/86)*, UR.1.1.(a)*, UR.3.1.*, UR.3.2., UR.3.3.
Customer readability, if applicable	G-UR.3.3.
Adjustable components	S.1.10.
Provision for sealing	S.1.11.(a) (1/1/79),S.1.11. (b) (1/1/90), G-S.8. (1/1/90), G-UR.4.5.
5. Weighing element	S.4., UR.2.8.
Access	UR.2.5.
6. Installation	UR.2.3., UR.2.4., G-UR.2.

Check to be sure the scale supports are adequate to support the scale, test equipment, and test weights equal to the capacity of the scale!

7. Approaches

Vehicle scales	UR.2.6.1. (1/1/76)

8. Maintenance, use, and environmental factors	G-S.2., G-UR.1.2., G-UR.3.4., G-UR.4., UR.3.2., UR.3.3., UR.3.7., UR.3.8., UR.4.3.
9. Assistance	G-UR.4.4.

Pretest Determinations:

1. Tolerances:

Acceptance/maintenance	G-T.1., G-T.2.
Application:	
Scales marked with an accuracy class	T.N.2.1., T.N.2.3.,T.N.2.4.
Tolerance values:	
Scales marked with an accuracy class	T.N.3.1./Table 6 (Accuracy Class III L), T.N.3.2., T.N.4.1., T.N.4.4., T.N.5.
Scales not marked with an accuracy class	T.1.1., T.N.3.1./Table 6 (Class III L),T.N.3.2., T.N.4.1., T.N.4.4., T.N.5.
Discrimination	T.N.7.2.

2. Determine maximum test load to be applied during test:

A test load not to exceed marked concentrated load capacity (or for scales manufactured prior to January 1, 1989, themarked section capacity) may be applied to any section or between any two sections. A test load of 100 percent of capacity may be distributed over the entire platform.

3. .Minimum test weights and test loads — N.3.

(**Note:** Term "recommended' to be deleted 1/1/94.)

Test notes:

Wear appropriate personal protection equipment such as safety shoes to prevent possible injury from falling weights and slipping on slick surfaces and a hard hat to prevent injury from overhead hazards

1. Check repeatability of, and agreement between, indications throughout test — G-S.5.2.2.(a), G-S.5.2.2. (c)

2. Recheck zero-load balance each time test load is removed — N.1.9., G-UR.4.2.

3. If the scale is equipped with a printer, print ticket at each test load. If the device will print only one load without returning to "zero", check printer with at least four different loads at convenient times during test. Check effectiveness of motion detection — G-S.5.6., S-2.5.1.(a), UR.1.3. (1/1/86)*

4. If, during the conduct of the test, the performance of the device is questionable with respect to the zone of uncertainty and the width of zero, tests may be conducted to determine compliance	N.1.5. (1/1/86)*, N.1.5.1., S.1.1.1.
5. If the device is equipped with operational features such as programmable tare, multiple tare memory, weigh-in/weigh-out, or multiple weighing elements,check proper operation and appropriateness	G-UR.4.1., G-UR.4.2., S.4.3.

Test:

Wear Safety Shoes! Use Proper Lifting Techniques!

1. Discrimination test at zero load, if deemed necessary and if environmental conditions can be controlled	N.1.5. (1/1/86)*, N.1.5.1.
2. Increasing-load and shift (section) test	N.1.1., N.1.3.4.

Use at least two different loads successively distributed anywhere on the load-receiving element using the prescribed test patterns and maximum test loads specified below.

Test pattern: An area at least 4 feet long and a width equal to the width of the scale platform. When loading the scale for testing, one side of the test pattern shall be loaded to no more than one-quarter of the concentrated load capacity before loading the other side.

Multiple pattern loading: To test to the nominal capacity, multiple patterns may be simultaneously loaded in a manner consistent with the method of use.

Other designs: Special design scales and those that are wider than 12 feet shall he tested in a manner consistent with the method of use but following the principles described above.

Test load: The maximum test load applied to the prescribed test pattern shall not exceed the concentrated load capacity (or for scales manufactured prior to January 1, 1989, the rated section capacity).

Note: When testing scales manufactured prior to January 1, 1989, caution should be exercised when loading test weights equivalent to the rated section capacity onto areas between sections.

Note: When loading the first section to be tested, it is recommended that observations be made at each increment of test weight application.

3. RFI/EMI Test (if a problem is suspected). Conduct test with equipment and under conditions that are usual and customary with respect to location and use of the scale

G-N.2., G-UR.3.2., G-UR.4.2.,G-UR.1.2., N.1.6., T.4., T.N.9.*

4. Decreasing-load test, at one-half of maximum test load	N.1.2., N.1.2.2.
5. Strain-load test on at least two sections; apply tolerance to test weight load only	N.1.1.
6. Discrimination test at maximum test load, if deemed necessary and if environmental conditions are controlled	N.1.5. (1/1/86)*, N.1.5.1.
7. Over-capacity test (if practical)	S.1.7.
8. Recheck zero-load balance change	N.1.9., G-UR.4.2.
9. Test for proper design of automatic zero-setting mechanism, if device is so equipped	S.2.1.3.(b) (1/1/81)
10. If equipped with a semi-automatic zero-setting mechanism (push button), test effectiveness of motion detection	S.2.1.2.(a)
11. Check proper design of tare auto-clear, if device is so equipped	S.2.3. (including note for auto-clear 1/1/83)
12. Establish correct zero-load balance.	

Maximum Values of
Multiple Load Cell Scales
(Table values are in pounds.)

Load Cells	Scale Division 1 lb	2 lb	5 lb	10 lb	20 lb	50 lb	100 lb
2	0.71	1.41	3.54	7.07	14.1	35	70
4	0.50.	1.00	2.50	5.00	10.0	25	50
6	0.41	0.82	2.04	4.08	8.2	20.4	41
8	0.35	0.71	1.77	3.54	7.1	17.7	35
10	0.32	0.63	1.58	3.16	6.3	15.8	32
12	0.29	0.58	1.44	2.89	5.8	14.4	29
14	0.27	0.53	1.34	2.67	5.4	13.4	27

Full electronic scales

Example: For a vehicle scale with four sections (eight load cells) and a displayed scale division of 20 lb, the maximum value permitted for each load cell is 7.1 lb. The calculation is shown below. If the value marked on the load cell is less than or equal to the value computed for the v_{min}, then the load cell is considered to comply with T.N.8.1.3.

$$v_{min} \# \frac{d}{\sqrt{n}} = \frac{20\text{ lb}}{\sqrt{8}} = \frac{20\text{ lb}}{2.83} = 7.07 \text{ . } 7.1\text{ lb}$$

Lever-tronic Scales

Example: Calculate the multiple of the lever system from the ratios marked on the levers. Suppose the multiple for a vehicle scale is 400:1 and that the scale has a scale division of 20 lb. Then the maximum value for the v_{min} of the load cell is 0.05 lb. The calculation is shown below. If the load cell is marked with v_{min} less than or equal to the calculated value, then the load cell is considered to comply with T.N.8.1.3.

$$v_{min} \# \frac{d}{\text{scale multiple}} = \frac{20\text{ lb}}{400} = 0.05\text{ lb}$$

m. Track Scale Test

(1) General

Railway track scales used for official grain weight certification must be tested semiannually. To accomplish these tests, FGIS uses three test cars, each of which consists of a specially fitted boxcar containing at least 100,000 pounds of test standards in 10,000-pound blocks and one calibrated electric truck (5 feet wheel base) to carry and move the block standards. Other test cars may be used for official testing purposes provided the cars have been certified on an approved master scale within the period of 1 year and are at least 30,000 pounds. (H-44, 1994, N.3.1. in part)

(2) Section Test

(a) General

1) The section test on railway track scales shall be performed bidirectionally; that is, from one direction then repeating in the opposite direction.

2) The test involves the placement of a test car on a prescribed test point, recording the weight, and repeating on succeeding sections. The sections of a railway track scale are numbered 1, 2, 3, etc., from left to right when standing at the weighbeam or indicator, and facing the scale.

a) Normal positions of a test car are designated in order from left to right as: 1R, 2L, 2R, 3L, 3R, 4L, etc. The numbers representing the sections and the letters, when affixed, indicates that the body of the car lies to the left or right of the section with one pair of wheels directly over the section.

b) In the case of a two section scale, an additional position is used with the center of the car midway between the sections. This position is designated as "center" (C).

c) Do not position a test car beyond the load bearing points of a box car unloading scale due to the danger of tipping the scale.

3) The indications of each section must be within the applicable tolerance applied to the known test standards.

4) The maximum deviation between indicated values on the test standards applied to individual sections shall not be greater than the absolute value of the maintenance tolerance.

(b) Procedures

1) Balance the beam at the zero poise setting using the balance ball. Set the dial to zero or adjust the digital indicator to a stable zero. If error/balance weights will be used to determine error, balance out weights on the load-receiving element equal to the tolerance allowed for the amount of test standards to be applied.

2) Apply the test standards to section 1.

NOTE: Prior to moving the standards, examine the bolts, connectors, chains, and hooks. Do not use any equipment that shows signs of wear or fatigue.

3) Move the poise to the graduation equivalent to the amount of test weights. If the beam balances, record error as zero. If it does not balance, then add or remove error/balance weights until the beam balances.

4) Record the number of divisions of error/balance weights added or removed. Record the reading on the dial or digital indicator and record the error.

5) Continue testing all sections in one direction. Then remove the test standards and check zero balance.

(3) Strain Test

(a) When only one test car is available, a light car or empty general service type car can be used in combination with the test car for testing the scales to higher weight ranges.

(b) The weight value of the light weight car (empty) should not exceed the weight value of the test standards. The length of the light car has to be considered as there must be room to place both cars on the scale simultaneously.

(c) Move the light car onto the weigh rails and record indication.

(d) Move the test car onto the weigh rails with the light car and record the indication. Utilize error/balance weights to determine error on the weighbeam scale. The applicable tolerance shall only apply to the test car weight value.

(e) Remove both test car and light car and check zero balance and record.

(4) Standard Graduated Test

A standard graduated test is one made when two test cars are available. Positions and placements coincide with the section test listed previously.

(a) Spot one test car (preferably the light car) on one of the predetermined positions and record sectional indications and error.

(b) Spot both test cars on the weigh rails simultaneously, the center lines of the test cars separated by approximately the same distance as would result between the center line of the trucks when weighing a freight car. Record the positions, indications, and scale error.

(5) Decreasing-Load Test

A decreasing-load test shall be conducted on automatic-indicating scales.

n. Platform Scale Test

(1) General

(a) For the purpose of this instruction, "platform scales" are portable, low capacity bench-type scales that are used for checkweighing, Class X weighing or Class Y weighing of sacked grain, rice and other commodities.

(b) Platform scales shall be tested twice a year at approximately a 6-month interval by FGIS or a State Weights and Measures Official.

(c) A complete set of Class F weights is required to perform the platform scale tests. The weight set should contain at least the following weights: 50 lb (2), 10 lb (2), 5 lb, 2 lb (2), 1 lb, .5 lb, .2 lb (2), .1 lb, .05 lb, .02 lb (2), .01 lb, .005 lb, .002 lb (2), and .001 lb.

(d) Conduct the tests in the following order: sensitivity test, shift test, increasing-load test, (and when applicable, decreasing-load test) zero balance shift test, and dial test.

(2) Tolerances

(a) FGIS-Owned, Unmarked[1] Mechanical Scales (Capacity greater than 100 lb), such as the Accuweigh TDX 301. See Tables 11 and 13 of this chapter for scales where n > 5000.

(b) All Other Scales

See the applicable type scale in Section 3.4 of this Chapter. (3) Sensitivity Test

[1]Unmarked scales are those manufactured prior to January 1, 1986, that are not marked with a National Institute of Standards and Technology, Handbook 44 accuracy class designation; i.e., II, III, or III L.

(a) FGIS-Owned, Unmarked Mechanical Scales (Capacity greater than 100 lb), such as the Accuweigh TDX 301

1) Balance the scale with a zero-load.

2) Place .1 pound test weight on the scale and note the scale's response.

3) If the weighbeam comes to rest at the limiting stop, the scale meets the sensitivity requirement (SR) and is acceptable.

4) Record the results on Form FGIS-965-2, Scale Test Report - Vehicle.

(b) All Other Scales

1) See Section g., of this section for procedures for conducting a sensitivity test.

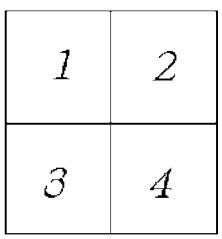
2) See Section 3.4, d., of this Chapter for the sensitivity requirements for all other scales.

(4) Shift Test

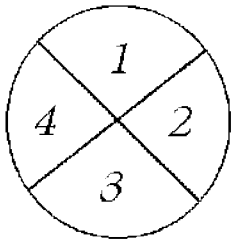
The shift test is used to determine scale accuracy when off-center loads are applied to the platform.

(a) Place a test load equivalent to at least one-half maximum capacity of the scale successively in the center of each quadrant of the load-receiving element. Do not place the test load at the extreme edge of the platform.

(b) The quadrants are numbered as follows:



Square-Type



Round-Type

If the weight indicated by the scale is within the applicable tolerance see Tables 11 and 13 for the test load applied, the scale's shift test response is acceptable.

For example:

Where the tested or certified capacity is 110 pounds on the Accuweigh TDX 301.

$$\frac{\text{½ capacity}}{(d)} = \frac{55 \text{ lb}}{.1} = 550d = \pm 2d \text{ (from table 13)} = \pm .2 \text{ lb tolerance}$$

(c) Record the results on Form FGIS-965-2, Scale Test Report - Vehicle.

(5) Beam-Type Scale Increasing Load Test

This test is used to determine scale accuracy at various loads up to maximum scale capacity.

(a) Balance the scale at zero-load.

(b) Apply the test load to the center of the load receiving element. Test each secondary poise at one-half and full capacity (maximum weight marked on the beam being tested); test the primary poise at one-half and at the maximum-used capacity. Note and record the results on Form FGIS-965-2, Scale Test Report - Vehicle.

(c) If the scale indications are in tolerance (according to Tables 11 and 13 for maintenance tolerances in this Chapter where n # 5000 d) for all test loads applied, the scale meets the increasing-load requirement.

(d) Upon completion of the increasing-load test, remove the weights from the scale and perform a zero balance shift test (does the scale return to zero). Note and record the results on Form FGIS-965-2, Scale Test Report - Vehicle (see Section 3.1, d. (5) (d))

Example: Platform Scale Tests Performed on an Accuweigh TDX 301.

Step 1. Balance the scale with no load (no weights) on the platform. Place a .1 lb class F test weight on the center of the platform. If the beam comes to rest at the limiting stop, the scale is acceptable (Sensitivity Test).

Step 2. Place a total of 150 lb of class F test weights on center of the upper left hand quarter of the scale platform. If the scale indicates 150 lb, ± .2 lb, the scale is acceptable. Repeat this test on the other three quarters of the scale platform (Shift Test).

Step 3. Determine the capacity and division size of each beam:

Secondary Poise A has a capacity of 2 pounds X .01 pound. (On this scale the .01 lb poise shall not be used officially)

Secondary Poise B has a capacity of 5 pounds X .1 pound.

The Primary Poise has a capacity of 300 pounds X 5 pounds, but in this example the scale is only used to weigh products up to 110 pounds.

Step 4. For each beam, place test weights centered on the scale approximately equal to the beam's half-capacity and full capacity (or up to the used capacity - 110 lb), and record this weight on the test form. Note that we apply a

minimum tolerance of ½ d or .05 lb. (Increasing Load Test)

Table 15 Tolerance on Beams for the Accuweigh TDX 301

Poise	Test Load	Indication	Error	Maintenance Tolerance	Result
A	(Do Not Test)				
B	2.5	2.5	.0	±.1	(In Tolerance)
B	5	5.1	.1	±.1	(In Tolerance)
Primary	50	50.1	.1	±.1	(In Tolerance)
Primary	110	110.3	.3	±.2	(Exceeds Tolerance)

Step 5. Remove the weights from the platform and note the scale response with no load applied (zero balance shift test). In order to be acceptable, the scale should indicate "0", plus or minus 1 d or .1 lb.

(6) Digital Scale Increasing Load Test

(a) Zero the scale at zero-load.

(b) Apply the test load to the center of the load receiving element. Test the scale at one-half and full capacity. Note and record the results on Form FGIS-965-2, Scale Test Report - Vehicle.

(c) If the scale indications are in tolerance [see n. (2)] for all test loads applied, the scale meets the increasing-load requirement.

(d) Upon completion of the increasing-load test, remove the weights from the scale and perform a decreasing-load test and a zero balance shift test (does the scale return to zero). Note and record the results on Form FGIS-965-2, Scale Test Report - Vehicle (attached).

Example: Platform Scale Tests Performed on an Ohaus PL 150. (150 lb x .1 lb) Step 1. Zero the scale with no load (no weights) on the

platform. Turn off automatic-zero tracking. The center of zero indicator must be on, indicating that the scale is within .3 division from zero. (If automatic-zero tracking can not be turned off, conduct the test outside the range of auto zero by applying approximately 1 lb to the platform.) Place .14 lb of class F test weight on the center of the platform. If the indicator changes by at least 1 division, the scale is acceptable.

Step 2. Place a total of 75 lb of class F test weights on center of the upper left hand quarter of the scale platform. If the scale indicates 75 lb ±.2, the scale is acceptable. Repeat this test on the other three quarters of the scale platform. (Shift Test)

Step 3. Determine the capacity that the scale will be tested to:

The scale has a capacity of 150 pounds X .1 pound, but in this example the scale is only used to weigh products up to 100 pounds. Place test weights centered on the scale equal to half-capacity and full capacity (up to the used capacity - 100 lb), and record this weight on the test form. (Increasing Load Test)

Table 16 Increasing Load Test Error

Test Load	Indication	Error	Maintenance Tolerance	Acceptance Tolerance
50	50.1	.1	.1	.05
100	100.1	.1	.2	.1

Step 5. Remove the weights from the platform to decrease the load to one-half capacity (50 lb) and note the indication is 50 ± .1 lb. (Decreasing Load Test)

Step 6. Remove the weights from the platform and note the scale response with no load applied (zero balance shift test). The scale should indicate 0 ± .1 lb.

(7) Decreasing-Load Test

A decreasing-load test shall be conducted on automatic-indicating scales only. Test the scale with a test load equal to one-half of maximum-used capacity of

the scale, centered on the load-receiving element of the scale. (8)Dial Test

Test the dial at no less than four points on the reading face, including all possible quarters of the reading face capacity. Test all unit weights, if so equipped.

o. Testing and Calibration Procedure for Master Railway Track Scales

(1) Visual Inspection

(a) Inspect the scale deck for wear and check for binds between the weigh rail and the approach rail.

(b) Measure the gap between the weigh rail and the approach rail. If this distance is less than **c** inch or more than **d** inch, the owner must make adjustments prior to the test.

(c) Inspect the scale pit for cleanliness and dryness.

(d) Inspect all mechanical connections of the lever system. While performing this inspection, put the blade edge of a screw driver between lever and the side of the clevis at the pivot point, adjust so there is equal distance on both sides between the clevis and the lever.

(e) Inspect the weighbeam, poise, butt connections, and counterpoise tip loop connections. Use the same procedure as employed in the inspection of the lever system.

(2) Preliminary Setup

(a) Attach the flexible pointer that is found in the butt-ratio weight kit to the trig loop.

(b) Attach a ruled chart to the weighbeam as close as possible to the tip clevis assembly.

(c) Set up a magnifying glass so that while reading the turning points there will not be a parallax between the pointer and the graduated divisions on the ruled scale.

(d) Measure 6 inches from the left and right end of the scale rail on the weighbeam side and place a chalk mark at these 2 points on the outside of the rail.

(e) Divide that distance between the two marks into four parts and mark. Number all the marks l through 5 from left to right.

(3) Test Procedure

The method for determining error in the testing of a railway master scale is by applying weights to the test load and comparing those weights to the weight that was used on the scale rail at zero balance. The differences in these weight values are identified as plus or minus errors. However, on plate fulcrum master scale this method need not be used as the plate fulcrum scale has a vernier fractional bar attached to the weighbeam. This fractional bar is calibrated in 0.1 pound, therefore, by moving the poise to acquire the acceptable turning points for the beam and using the poise reading, true error can be determined without the use of error weights.

(a) Place a 10-pound weight on the weigh rail without any counterbalance weight on the tip dish. Adjust the balance ball until the beam swings equidistant above and below the center mark of the ruled scale. The number of divisions of swing above and below should not exceed twenty. (Dampen the beam swing by hand stroking it in the direction of the tip.)

(b) Enter test data on the "Master Scale Test Record" as indicated in Attachments 14 and 15.

(c) Remove the 10,000-pound weight dolly from the test weight car.

NOTE: Prior to moving the standards, examine all the bolts, connectors, chains, and hooks. Do not use any equipment that shows signs of wear or fatigue.

(d) Load two 10,000-pound weights on the dolly.

(e) Plug the electrical cable into the dolly.

(f) Place three 10-pound weights onto the tip dish at the end of the weighbeam.

(g) Remove the balance weights from the weigh rail and place them on the weight dolly.

(h) Activate the dolly electrical control handle until the dolly will move onto the scale.

(i) Stop the dolly so that the rear wheel is centered over the first chalk mark on the left end of the scale rail.

(j) Remove the electrical cable from the dolly.

(k) Unlock the weighbeam. Dampen the beam movement with your hand until the beam swings consistently up and down. The range of the swing in relation to the pointer and scale should be between 13 and 7 divisions. If the swing is too high or too low, remove or add trim or error weights from or to the dolly in one pound increments until the range is acquired. The amount of trim or error weight left on the dolly is recorded on the test record. Record the turning points of the beam from the weighbeam chart on the test record.

(l) Determine sensitivity by adding or removing error weights in one pound increments from the test load (dolly) and record the turning points and compute. Record the error or trim weight now on the dolly.

(m) Dampen the beam gently to the bottom of the trig loop and lock. Connect the electrical cable to the dolly and move to position number 2 (second chalk mark on the rail). Remove electrical cable from the dolly and repeat step k. Sensitivity is not taken at this position.

(n) Continue this procedure until all 5 test positions have been completed. Always locking the beam when moving to the next position.

(o) Remove the test load (dolly) from the scale. In most cases it should be removed from the right end. However, in some cases there is not enough clearance off the right end and the dolly must be reversed and removed from the left end.

(p) Remove the trim or error weights from the test load and remove the counterweights from the tip dish at the end of the weighbeam. Place the trim or error weights taken from the test load (dolly) and place them on the weigh rail and determine the balance change of the scale that occurred during the test. Use the same procedure to make the balance change determination as was used to determine zero balance.

(q) Place the three 10-pound counterpoise weights on the tip dish at the end of the weighbeam, remove the trim or error weights from the scale rail and place them on the weigh dolly.

(r) Repeat steps h through p in the opposite direction starting at position number 5 from the right end of the scale. However, in those cases where there is not enough clearance on the right end of the scale, the dolly must be moved onto the scale from the left end to position number 5. The testing positions are reversed with the sensitivity being taken at positions 2 and 4 until all 5 positions have been tested.

(s) When all positions have been tested, remove the dolly from the scale, unload the tip dish, remove the trim error weights from the test load (dolly), and determine balance change.

(t) Load seven more 10,000-pound weights from the test car onto the dolly. Place seven more 10-pound weights on the tip dish at the end of the weighbeam. There are now 100,000 pounds of test weights to load on the scale and 100 pounds of counterweight on the tip dish.

(u) This test run is conducted using the same testing sequence as was used at the 30,000-pound loading.

(v) The next step is to determine if the amount of error, which has been calculated and entered in column 26 (ERROR) of the test record, is within the tolerance prescribed for railway master scales listed below.

Table 17 Tolerances for Master Railway Track Scale Test

	TOLERANCE IN POUNDS	
LOAD IN POUNDS	**MAINTENANCE TEST**	**ADJUSTMENT TEST**
30,000	-------	3.7
40,000	8.4	4.2
50,000	-------	4.7
60,000	10.4	5.2
70,000	-------	5.6
80,000	12.0	6.0
90,000	-------	6.4
100,000	-------	6.7

(w) If the errors exceed these established tolerances and an adjustment is necessary, inform the owner of the scale of which test position or positions the scale exceeded tolerance and have the owner adjust the scale.

(x) After the adjustments have been made, the 30,000 and 100,000-pound test loads must be applied to the scale again using the same test procedure.

(y) When the results of the test data from the 30,000 and 100,000-pound loadings indicate the scale meets the tolerance requirements at those loads, the remainder of the test loads may be applied to the scale using the same testing sequence and procedure.

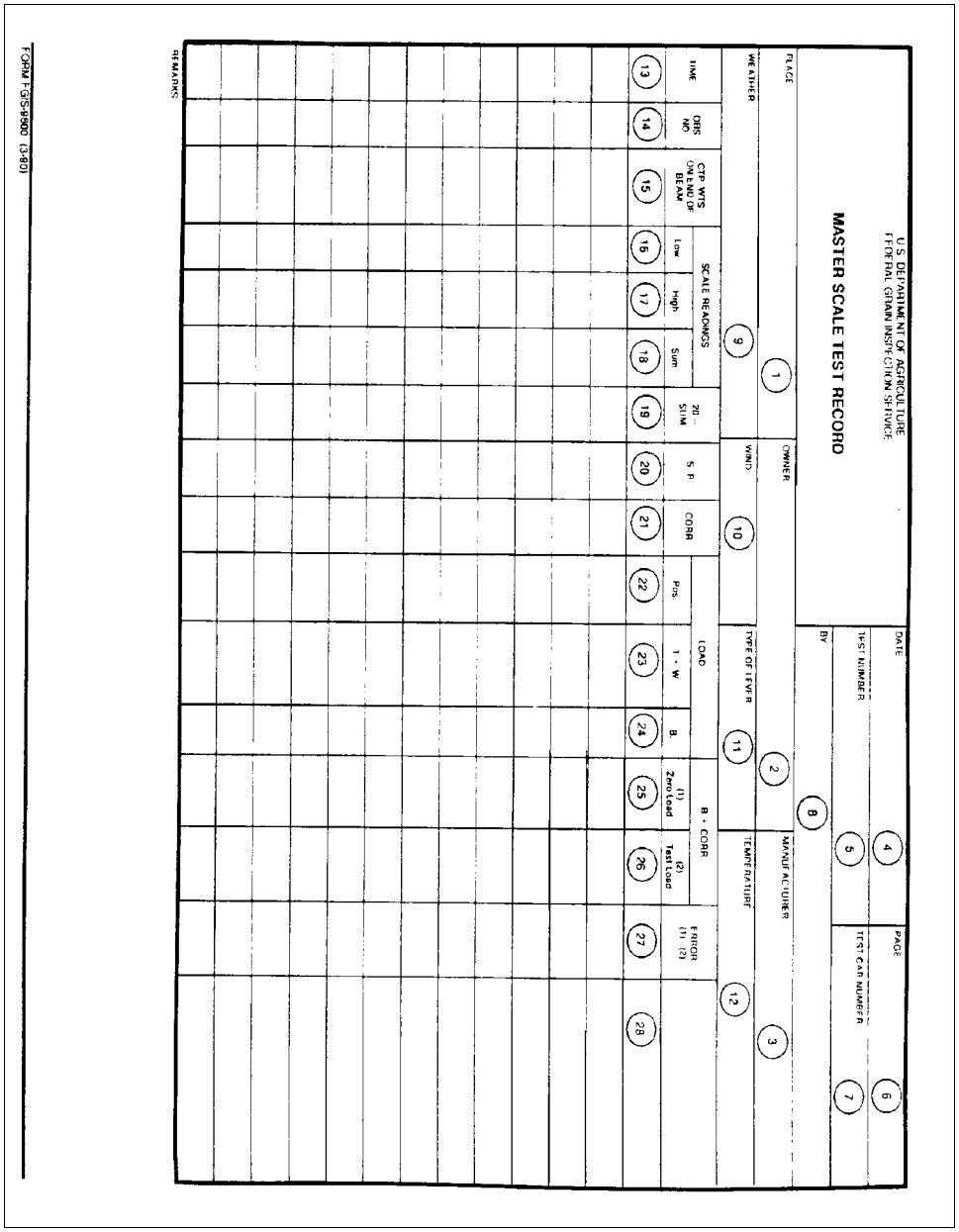
(z) Distribute the "Master Scale Test Record" as follows.

1) White copy to the Weighing and Equipment Branch, FM, Washington, D.C.

2) Pink copy to the owner to be retained at the master scale site.

3) Second pink copy to the State Weights and Measures authority in which the scale is located.

Master Scale Test Record



ATTACHMENT 15
WEIGHING HANDBOOK
CHAPTER 3
3.5 TEST PROCEDURES
9/20/96

Instructions for Completing Master Scale Test Record

1 Place. The city and state of the scale's location.

2 Owner. Indicate the owner of the scale.

3 Manufacturer. The name of the company who manufactured the scale.

4 Date. The month, day, and year of the test.

5 Test No. Enter the preassigned test number.

6 Page. Enter the page number.

7 Test Car Number. Enter the number of the FGIS test car.

8 By. Enter the initials of the person or persons testing the scale.

9 Weather. Enter the weather condition outside the building ; i.e., warm, cold, snow, rain, etc.

10 Wind. Enter wind condition and direction.

11. Type of Lever. Enter "G" , strait lever, or "S", plate fulcrum.

12 Temperature. Enter the temperature at the scale.

13 Time. Enter the time.

14 Obs. No. Enter the observation number.

15 CTP Wts. on End of Beam. Enter the weight value on counterpoise tip hanger on the end of the beam.

16 Low. Enter the low reading of the beam swing according to the pointer scale division relationship.

17 High. Enter the high reading of the beam swing according to the pointer scale division relationship.

If the readings entered in columns 15 and 16 are the first reading after the beam has been released and dampened, a line must be drawn under so as to designate it as the
first reading.

18 Sum. Enter the sum of the readings. Average the two low or high readings and add to the one remaining reading that is left after you have "thrown out" the first reading that was underlined.

19 20 - Sum. Enter the divisional difference of the number in column 16 and the number 20.

20 S.R. Enter the Sensitivity Reciprocal in pounds. To determine the S.R. subtract the small number from the large number in the sum column l7 and enter that number in column 27 and divide that number into l.0 pound. The results will produce the S.R. for a l-pound change on the weigh rail.

Example:
Obs l sum col. l9.0 div = l0 lb on rail or load
Obs 2 sum col. 23.6 div = ll lb on rail or load
Difference 4.6 div = l lb
l lb: 4.6 div = .22 lb
l div = .22 S.R. in column l9.

S.R. will be taken at positions l, 3, and 5 at all odd number runs and position 2 and 4 at all even runs.

21 Corr. Enter the correction. To determine correction, multiply the number in column l8 by the number in column l9. This product is the correction. Assign column l9 ± value the same as column l8.

22 Pos. Enter the position that the weight dolly is positioned on the scale rail l thru 5. If you are checking zero with the dolly off the scale, enter 0 in this column.

23 T + W. Enter the value of the test load on the scale 30,000 through l00,000 pounds. If checking balance with no load, enter 0 in this column.

24 B. Enter the value of the trim or error weights that are being used to determine the balance condition of the scale on the weights that are added to the test load to bring the sum of the turning points to as close to zero as possible.

25 Zero Load. Enter the amount of weight in column 23 plus the correction as recorded in column 2.

26 Test Load. Enter the value of the trim or error weight in column 23 plus or minus the correction in column 20.

27 Error. Enter the difference of the entries in column 25 and mean of the two entries in column 24. To calculate the value of zero load in column 24, use the weight value, ± correction that produced the turning points to the sum nearest to 20 when determining the zero balance of the scale. Then use the same method of selection when completing the run. The mean will be the average of the top and bottom entries in column 24. Place that mean midway between the
two and use the word "mean" over the entry.

28 Column 27 is used to compute S.R. Use the divisional change for a 1-pound weight being placed on or taken off the scale rail or the test load.

3.6 DEFINITIONS

a. Meaning of Terms

Words used in the singular form in this subpart shall be considered to imply the plural and vice versa, as appropriate.

b. Definition of Terms

1. Absolute Value. The absolute value of a number is the magnitude of that number without considering the positive or negative sign.

2. Accurate. A piece of equipment is "accurate" when its performance or value -- that is, its indications, its deliveries, its recorded representation, or its capacity or actual value, etc., as determined by tests made with suitable standards -- conforms to the standard within the applicable tolerances and other performance requirements. Equipment that fails to conform is "inaccurate." (See also correct.)

3. Analog Type. A system of indication or recording in which values are presented as a series of graduations in combination with an indicator, or in which the most sensitive element of an indicating system moves continuously during the operation of the scale.

4. Anti-friction Point. A sharp slight projection formed on the knife-edge line of a pivot or inserted in or attached to a lever for contacting a thrust plate.

5. Applied Load. The force of weight on a load receiving element of a scale beyond that required to maintain the zero-load balance. Sometimes also called "live load."

6. Approach Rail. One of the rails of track approaching a scale.

7. Approval Label. A label indicating official approval of a scale. (See Security Seal.)

8. Automatic Bulk Weighing System. A weighing system adapted to the automatic weighing of bulk commodities in successive drafts of predetermined

amounts, automatically recording the no-load and loaded weight values and accumulating the net weight of each draft.

9. Automatic Hopper Scale. One adapted to the automatic weighing of a bulk commodity in successive drafts of predetermined amounts. (This is not necessarily an "Automatic-indicating scale" defined below.)

10. Automatic-Indicating Scale. One on which the weights of applied loads of various magnitudes are automatically indicated throughout all or a portion of the weighing range of the scale. (A scale that automatically weighs out commodity in predetermined drafts, such as an automatic hopper scale, and the like, is not an automatic-indicating scale).

11. Automatic Zero-setting Mechanism. Automatic means provided to maintain zero balance indication without the intervention of an operator, also known as automatic zero-maintenance (AZM).

12. Automatic Zero Reset. A means or circuit to return an indicator to zero from any reading within the nominal capacity of the scale.

13. Auxiliary Indicator. Any indicator other than the master weight totalizer that indicates the weight of material determined by the scale.

14. Avoirdupois Weight. A unit of weight based on the pound of 16 ounces (7000 grains) commonly used in the United States for official weighing of all commodities, except precious stones, precious metals, and drugs.

15. Balance Indicator. A combination of elements, one or both of which will oscillate with respect to the other, for indicating the balance condition of a nonautomatic-indicating scale. The combination may consist of two indicating edges, lines, or points, or a single edge, line, or point and a graduated scale.

16. Balance, Zero-load. See zero-load balance.

17. Balancing Mechanism. A mechanism (including a balance ball) that is designed for adjusting a scale to an accurate zero-load balance condition.

18. Basic Tolerances. Basic tolerances are those tolerances on underregistration and on overregistration, or in excess and in deficiency, that are established for a particular scale under all normal tests, whether maintenance or acceptance. Basic tolerances include minimum tolerance values when these are specified. Special tolerances, identified as such and pertaining to special tests, are not basic tolerances.

19. Beam. See weighbeam.

20. Beam Scale. One on which the weights of loads of various magnitudes are indicated solely by means of one or more weighbeam bars either alone or in combination with counterpoise weights.

21. Bench Scale. (See counter scale).

22. Binary Submultiples. Fractional parts obtained by successively dividing by the number 2. Thus, one-half, one-fourth, one-eighth, one-sixteenth, and so on, are binary submultiples.

23. Certificate of Conformance. A document issued by the National Institute of Standards and Technology based on testing by a Participating Laboratory, said document constituting evidence of conformance of a type with the requirements of National Institute of Standards and Technology Handbooks 44, 105-1. (See also Participating Laboratory.)

24. Certified Capacity. The maximum weight limit that has been approved by the Service for a scale for weighing under the Act. It is posted on the approved label for inspected machinery or scale test forms.

25. Checkweighing Scale. One used to verify predetermined weight within prescribed limits.

26. Clear Interval Between Graduations. The distance between adjacent edges of successive graduations in a series of graduations. If the graduations are "staggered," the interval shall be measured, if necessary, between a graduation and an extension of the adjacent graduation.

27. Concentrated Load Capacity. A capacity rating of a vehicle scale, specified by the manufacturer, defining the maximum load concentration for which the weighbridge is designed. This capacity rating is for both test and use.

28. Correct. A piece of equipment is "correct" when, in addition to being accurate, it meets all applicable specifications requirements. Equipment that fails

to meet any of the requirements for correct equipment is "incorrect." (See also accurate.)

29. Counterbalance Weight. An adjusted, removable (usually) slotted weight, intended to counterpoise an applied load of designed weight value. Sometimes also colloquially called "counterweight". Also, one intended for application near the butt of a weighbeam for zero-load balancing purposes.

30. Counterpoise Weight. A slotted or "hanger" weight intended for application near the tip of the weighbeam of a scale having a multiple greater than 1.

31. Creep. The change in load cell output occurring with time while under load and with all environmental conditions and other variables remaining constant.

32. Creep Recovery. The change in no-load output occurring with time after a removal of a load which had been applied for a specific period of time.

33. Damping Device. A device for arresting an oscillation by progressively diminishing its amplitude.

34. Dead Rail. Either rail of the independent track provided over a railway track scale for the movement of locomotives and cars not to be weighed.

35. Decreasing-Load Test. A test for automatic-indicating scales only, wherein the performance of the scale is tested when the load is being reduced.

36. Deficiency. See excess and deficiency.

37. Digital Type. A system of indication or recording of the selector type or one that advances intermittently in which all values are presented digitally, or in numbers. In a digital indicating or recording element, or in digital representation, there are no graduations.

38. Discrimination (of an Automatic-Indicating Scale). The value of the test load on the load-receiving element of the scale that will produce a specified minimum change of the indicated or recorded value on the scale.

39. Discrimination Test. A test conducted to determine sensitivity on all digital automatic-indicating scales with the weighing device in equilibrium at zero-load and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained.

40. Drift. A random change in output under constant load conditions.

41. Electromagnetic Interference (EMI). External electrical disturbances which propagate into electronic and electrical circuits and cause deviations from the normally expected performance. The frequency range of the disturbance covers the entire electromagnetic spectrum.

42. Electronic Scale. Any scale in which the restoring force is a transducer which converts force into an electrical signal proportional to weight and presents the information in digital or analog form.

43. Error. The algebraic difference between the indicated and true value of the load being measured.

44. Equal-Arm Scale. A scale having only a single lever with equal arms (that is, with a multiple of one), equipped with two similar or dissimilar load-receiving elements (pan, plate, platter, scoop, or the like), one intended to receive material being weighed and the other intended to receive weights. There may or may not be a weighbeam ("side bar").

45. Excess and Deficiency. When an instrument or device is of such a character that it has a value of its own that can be determined, its error is said to be "in excess" or "in deficiency," depending upon whether its actual value is, respectively, greater or less than its nominal value. Examples of instruments having errors "in excess" are: A linear measure that is too long, a liquid measure that is too large, and a weight that is "heavy." Examples of instruments having errors "in deficiency" are: A lubricating-oil bottle that is too small, a vehicle-tank compartment that is too small, and a weight that is "light."

46. Floating Rig. A waterborne grain handling and weighing system used to remove and weigh grain from barges directly to other waterborne carriers.

47. Fractional Bar. A weighbeam bar of relatively small capacity, for obtaining indications intermediate between notches or graduations on a main or tare bar.

48. Graduated Interval. The distance from the center of one graduation to the center of the next graduation of a series of graduations. (See also value of minimum graduated interval.)

49. Graduation. A defining line, or one of the lines defining the subdivisions of a graduated series. The term includes such special forms as raised or indented or scored reference "lines" and special characters such as dots. (See also main graduation, subordinate graduation.)

50. Grain Handling System. The physical arrangement including equipment, devices, and structures whereby grain is weighed with one or more scales and delivered or conveyed to a carrier or container, or unloaded from a carrier or container and delivered to one or more scales to be weighed.

51. Grain Hopper Scale. One adapted to the weighing of individual loads of varying amounts of grain.

52. Hysteresis. The maximum difference between load cell output readings for the same applied load; one reading obtained by increasing the load from zero and the other by decreasing the load from rated output.

53. Grain-Test Scale. A scale adapted to weighing grain samples used in determining moisture content, dockage, weight per unit volume, etc.

54. Hopper Scale. A scale designed for the bulk weighing of commodities whose load-receiving element is a tank, box, or hopper mounted on a weighing element. See also automatic hopper scale and grain hopper scale.

55. Inclinometer. An instrument for indicating the inclination to the horizontal of an axis of a ship.

56. Increasing-Load Test. The normal basic performance test for a scale in which observations are made as increments of test load and are successively added to the load-receiving element of the scale.

57. Increment. The value of the smallest change in value that can be indicated or recorded by a digital scale in normal operation.

58. Index of an Indicator. The particular portion of an indicator that is directly used in making a reading.

59. Indicator, Balance. See balance indicator.

60. Indicating Element. An element incorporated in a scale by means of which its performance relative to quantity is "read" from the scale itself as, for example, an index-and-graduated-scale combination, a weighbeam and poise combination, a digital indicator, and the like. (See also primary indicating or recording element.)

61. Interlock. A mechanism designed to prevent an action or indicate the presence of an occurrence in a scale system or a grain handling system.

62. Interval, Clear, Between Graduations. See clear interval between graduations.

63. Interval, Graduated. See graduated interval.

64. Levertronic Scale. A scale in which the indicating and the recording devices can be activated either manually or electronically and which generally has one load cell mounted in the lever system.

65. List. To lean to one side, e.g., a barge, because grain is being unloaded all from one side and not the other.

66. Live Load. The load to be weighed (see applied load).

67. Load. The weight or force applied to a scale.

68. Load Cell. A device, whether electric, hydraulic, or pneumatic, that produces a signal proportional to the load applied.

69. Load-Receiving Element. That element of a scale that is designed to receive the load to be weighed; for example, platform, deck, rail, hopper, platter, plate, scoop.

70. Main Bar. A principal weighbeam bar, usually of relatively large capacity as compared with other bars of the same weighbeam. (On an automatic-indicating scale equipped with a weighbeam, the main weighbeam bar is frequently called the "capacity" bar.)

71. Main Graduation. A graduation defining the primary or principal subdivisions of a graduated series. (See also graduation.)

72. Maintenance Tolerance. A tolerance for application under test conditions to a scale in service; usually applied to errors "as found." This is also called "users" tolerance.

73. Main-Weighbeam Elements. The combination of a main bar and its fractional bar, or a main bar alone if this has no fractional bar associated with it.

74. Manual Scale. A scale in which the weight-indicating and the weight-recording devices are activated by hand.

75. Manual Zero-setting Mechanism. Nonautomatic means provided to attain a zero balance indication by the direct operation of a control.

76. Metric Weight. A unit system of weight based on the kilogram of l,000 grams.

77. Minimum Division. The value of the smallest unit that can be indicated or recorded by a digital device in normal operations.

78. Minimum Test Load. The minimum allowable weight used for testing the accuracy of a scale.

79. Minimum Tolerances. Minimum tolerances are the smallest values that can be applied to a scale. Minimum tolerances are determined on the basis of the value of the minimum graduated interval or the nominal or reading capacity of the scale.

80. Motion Detection. The process of sensing a rate of change of applied load to determine when a given weighing system has reached a state of equilibrium.

81. Multiple of a Scale. In general, the multiplying power of the entire system of levers or other basic weighing elements. (On a beam scale, the multiple of the scale is the number of pounds on the load-receiving element that will be counterpoised by l pound applied to the tip pivot of the weighbeam.)

82. Multi-Revolution Scale. An automatic-indicating scale having a nominal capacity that is a multiple of the reading-face capacity and that is achieved by more than one complete revolution of the indicator.

83. National Type Evaluation Program. A program of cooperation between the National Institute of Standards and Technology, the National Conference on Weights and Measures, the States, and the private sector for determining, on a uniform basis, conformance of a type with the relevant provisions of:

National Institute of Standards and Technology Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Device;"

National Institute of Standards and Technology Handbook 105-1, "Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures, Specifications and Tolerances for Field Standard Weights (NIST Class F);"

84. No-Load Reference Value. A positive weight value indication with no load in the load-receiving element (hopper) of the scale. (Used with automatic bulk weighing systems and certain single-draft, manually-operated receiving hopper scales installed below grade and used to receive grain.)

85. Nominal. Refers to "intended" or "named" or "stated," as opposed to "actual." For example, the nominal value of something is the value that it is supposed or intended to have, the value that it is claimed or stated to have, or the value by which it is commonly known. Thus, 1-pound weight, 1-gallon measure, 1-yard indication, and 500-pound scale are statements of nominal values; corresponding actual values may differ from these by greater or lesser amounts.

86. Nominal Capacity. The nominal capacity of a scale is (a) the largest weight indication that can be obtained by the use of all of the reading or recording elements in combination, including the amount represented by any removable weights furnished or ordinarily furnished with the scale, but excluding the amount represented by any extra removable weights not ordinarily furnished with the scale, and excluding also the capacity of any auxiliary weighing attachment not contemplated by the original design of the scale, and excluding any fractional bar with a capacity less than 2½ percent of the sum of the capacities of the remaining reading elements, or (b) the capacity marked on the scale by the manufacturer, whichever is less. (See also nominal capacity, hopper scale.)

87. Nominal Capacity, Hopper Scale. The nominal capacity of a hopper scale is the capacity as marked on the scale by the scale manufacturer, or the product of the volume of the hopper in bushels or cubic feet times the maximum weight per bushel or cubic foot, as the case may be, of the commodity normally weighed, whichever is less.

88. Nonretroactive. "Nonretroactive" requirements are enforceable after the effective date for:

a. scales manufactured within a State after the effective date;

b. both new and used scales brought into a State after the effective date; and

c. scales that have been used in noncommercial applications and are then being placed into commercial use after the effective date.

Nonretroactive requirements are not enforceable with respect to scales that are in commercial service in the State as of the effective date or to new equipment in the stock of a manufacturer or a dealer in the State as of the effective date. (H-44, 1994, G-A.6. in part)

89. Nose-iron. A slidable-mounted, manually-adjustable pivot assembly for changing the multiple of a lever.

90. Official Grain Weighing Equipment or Device. Any scale system used in weighing grain under the USGSA.

91. Out-of-Zero Balance. A weight indication or weight representation other than zero when there is no load on the scale load-receiving element.

92. Over-and-Under Indicator. An automatic-indicating element incorporated in or attached to a scale comprising an indicator and a graduated scale with a central or intermediate "zero" graduation and a limited range of weight graduations on either side of the zero graduation, for indicating weights greater than and less than the predetermined values for which other elements of the scale may be set. (A scale having an over-and-under indicator is classed as an automatic-indicating scale.)

93. Overregistration and Underregistration. When an instrument or device is of such a character that it indicates or records values as a result of its operation, its error is said to be in the direction of overregistration or underregistration,

depending upon whether the indications are, respectively, greater or less than they should be. Examples of devices having errors of "overregistration" are: A fabric-measuring device that indicates more than the true length of material passed through it; and a liquid-measuring device that indicates more than the true amount of the liquid delivered by the device. Examples of devices having error of "underregistration" are: A meter that indicates less than the true amount of product that it delivers; and a weighing scale that indicates or records less than the true weight of the applied load.

94. Parallax. The apparent displacement, or apparent difference in height or width, of a graduation or other object with respect to a fixed reference, as viewed from different points.

95. Participating Laboratory. A Federal or a State Measurement Laboratory authorized by the National Institute of Standards and Technology, in accordance with its program for the Certification of Capability of State Measurement Laboratories, to conduct a type evaluation under the National Type Evaluation Program. (FGIS is a Participating Laboratory.)

96. Pendulum. In general, a body suspended from a fixed point so as to swing freely to and fro or in a spatially restricted sense; and with respect to certain types of scales, an element consisting of a mass and a rigid arm connecting the mass to an axis of rotation.

97. Performance Requirements. Performance requirements include all tolerance requirements and, in the case of nonautomatic-indicating scales, sensitivity requirements (SR).

98. Platform Scale. A scale whose load-receiving element is a platform.

99. Poise. A movable weight mounted upon or suspended from a weighbeam bar and used in combination with graduations, and frequently with notches, on the bar to indicate weight values. (A suspended poise is commonly called a "hanging" poise.)

100. Potentiometer. A resistance unit having a variable or sliding contact which is positioned by the rotation or sliding of a shaft.

101. Primary Indicating or Recording Element. The term "primary" is applied to those principal indicating (visual) elements and recording elements that are designed to, or may be, used by the operator in the normal commercial use of a device. (Examples of primary elements are the visual indicators for scales not equipped with ticket printers or other recording elements and both the visual indicators and the ticket printers or other recording elements for scales so equipped.)

Exception. The term "primary" is not applied to an auxiliary element as, for example, the ability to produce a running record of successive weighing operations, this element being supplementary to one that determines individual weights. (See indicating element, recording element.)

102. Radio Frequency Interference (RFI). Radio frequency interference is a type of electrical disturbance that, when introduced into electronic and electrical circuits, may cause deviations from the normally expected performance.

103. Railway Track Scale. A scale especially designed for weighing railway cars.

104. Ranges, Weight. See weight ranges.

105. Rated Scale Capacity. That value representing the weight that can be delivered by the device in 1 hour.

106. Ratio Test. A test to determine the accuracy with which the actual multiple of a scale agrees with its designed multiple. This test is used for scales employing counterpoise weights and is made with standard test weights substituted in all cases for the weights commercially used on the scale. (It is appropriate to use this test for some scales not employing counterpoise weights.)

107. Reading Edge. With respect to certain forms of poises, the edge intended as the index.

108. Reading-Face. That portion of an automatic-indicating scale that gives a visible indication of the quantity weighed or measured. A reading-face may include an indicator and a series of graduations or present values digitally.

109. Reading-Face Capacity. The largest value that may be indicated on the reading-face, exclusive of the application or addition of any supplemental or accessory elements.

110. Recorded Representations. The printed, embossed or other representation that is recorded as a quantity by a weighing or measuring device.

111. Recording Element. An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded on a tape, ticket, card, or the like, in the form of a printed, stamped, punched, or perforated representation.

112. Repeatability. The degree of reproducibility among several independent measurements of the same test load under specified conditions.

113. Retroactive Requirement. "Retroactive" requirements, when used in this Handbook and the National Institute of Standards and Technology Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Device" are enforceable with respect to all equipment. (H-44, 1994, G-A.5.)

114. Scale. (See specific type of scale.)

115. Scale Division, Value of (d). The value of the scale division expressed in units of mass is the smallest subdivision of the scale for analog indication (d) or the difference between two consecutively indicated or printed values for digital indication or printing. (See also verification scale division.)

116. Scale Division, Number of (n). Quotient of the capacity divided by the value of the scale division.

$$n = \frac{Cap}{d}$$

117. Scale Section. A part of a vehicle scale consisting of two main load supports usually transverse to the direction in which the load is applied.

118. Scale System. A system for weighing grain, including the scale and all parts of the scale, and all equipment and structures that are immediately associated with, related to,

or are an integral part of the system whereby grain is delivered to the scale, is weighed, and is removed from the scale.

119. Seal. See approval label or security seal.

120. Sectional Capacity. The greatest live load which may be divided equally on the load pivots or load cells of a section without inducing stresses in any member in excess of the working stresses allowed for the load cells or levers and materials involved.

121. Section Test. A test in which the test load is applied over individual sections. This test is conducted to disclose the weighing performance of individual sections, since scale capacity test loads are not always available and loads weighed are not always distributed evenly over all main load supports.

122. Security Seal. A lead-and-wire seal, a pressure-sensitive seal sufficiently permanent to indicate its removal, or similar device attached to a weighing or measuring device for protection against or to indicate access to adjustment. (See also approval label.)

123. Selector-Type. Refers to a system of indication or recording in which the mechanism selects, by means of a ratchet-and-paw combination or by other means, one or the other of any two successive values that can be indicated or recorded.

124. Semi-automatic Zero-setting Mechanism. Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator.

125. Sensitivity (of a Nonautomatic-Indicating Scale). The value of the test load-receiving element of the scale that will produce a specified minimum change in the position of rest of the indicating element or elements of the scale.

126. Sensitivity Requirement (SR). A performance requirement for a nonautomatic-indicating scale; specifically, the minimum change in the position of rest of the indicating element or elements of the scale in response to the increase or decrease, by a specified amount, of the test load on the load-receiving element of the scale.

127. Shift Test. A test intended to disclose the weighing performance of a scale under off-center loading.

128. Span (structural). The distance between adjoining sections of a scale.

129. Specification. A requirement usually dealing with the design, construction, or marking of a weighing or measuring device. Specifications are primarily directed to the manufacturers of devices.

130. Strain-load Test. The test of a scale beginning with the scale under load and applying known test weights to determine accuracy over a portion of the weighing range. The scale errors for a strain-load test are the errors observed for the known test loads only. The tolerances to be applied are based on the known test load used for each error that is determined.

131. Subordinate Graduation. Any graduation other than a main graduation. (See also graduation.)

132. Summation Standard (S). A standard that consists of a conglomerate of smaller standards.

133. Tare Mechanism. A mechanism (including a tare bar) that is designed for determining or balancing out the weight of packaging material, containers, vehicles, or other materials that are not intended to be included in net-weight determinations.

134. Tare-Weighbeam Elements. The combination of a tare bar and its fractional bar, or a tare bar alone if this has no fractional bar associated with it.

135. Tolerance. A value fixing the limit of allowable error or departure from true performance or value. (See also basic tolerances.)

136. Trig Loop. The fixture through which the tip of the weight beam projects in usual construction, designed to restrict vertical angular motion of the weighbeam to designed limits.

137. Type. The term "type" shall be construed to mean a model or models of a particular measurement system, instrument, element, or a field standard that positively identifies the design. A specific type may vary in its measurement ranges, size, performance, and operating characteristics.

138. Type Evaluation. A process for the testing, examination, and/or evaluation of a type by a Participating Laboratory under the National Type Evaluation Program.

139. Underregistration. See overregistration and underregistration.

140. Unit Train. A unit train is defined as a number of contiguous cars carrying a single commodity from one consignor to one consignee. The number of cars is determined by agreement among consignor, consignee, and the operating railroad.

141. Unit Weight. One contained within the housing of an automatic-indicating scale and mechanically applied to and removed from the mechanism. The application of a unit weight will increase the range of automatic indication, normally in increments equal to the reading-face capacity.

142. User Requirement. A requirement dealing with the selection, installation, use, or maintenance of a weighing device. User requirements are primarily directed to the users of devices.

143. Usual and Customary. Commonly or ordinarily found in practice or in the normal course of events and in accordance with established practices.

144. Value of Minimum Graduated Interval. The value represented by the interval from the center of one graduation to the center of the succeeding graduation. Also, the increment between successive recorded values. (Also see graduated interval.)

145. Variable Division-Unit Scale. A scale so designed that the unit of weight of the scale division is selectable by the operator (e.g., gram, troy ounce, pennyweight).

146. Variable Division-Value Scale. A scale so designed that the value of the scale division, in the same unit of weight, increases at certain load values within the weighing range of the scale (e.g., 0 load to 5 pounds in 0.005-pound scale divisions, 5 pounds plus to 20 pounds in 0.010-pound scale divisions).

147. Vehicle Scale. A scale adapted to weighing highway, farm, or other large industrial vehicles (except railroad freight cars), loaded or unloaded.

148. Verification Scale Division, Value of (e). A value, expressed in units of weight and specified by the manufacturer of a device, by which the tolerance values and the accuracy class applicable to the device are determined. The verification scale division is applied to ungraduated devices and certain other devices used for weight classifying or weighing in predetermined amounts, and certain other Class I and II scales.

149. Weighbeam. An element comprising one or more bars, equipped with movable poises or means for applying counterpoise weights or both.

150. Weighbridge. In a large-capacity scale, the structural frame carried by the main bearings which supports the load-receiving element.

151. Weighing Element. That portion of a scale that supports the load-receiving element and transmits to the indicating element a signal or force resulting from the load applied to the load-receiving element.

152. Weighment. A single complete weighing operation.

153. Weight. (a) The force with which a mass is attracted toward the center of the earth by gravity. The true weight of an object is its weight as determined in a vacuum. The apparent weight in air of an object is its weight determined in air, and is less than the true weight by an amount equal to the true weight of the air displaced by the object, (b) an object, usually of metal, having a definite mass, that is designed for weighing or testing purposes, or as a counterpoise weight or a test weight.

154. Weight Ranges. Electrical or electro-mechanical elements incorporated in an automatic-indicating scale through the application of which the range of automatic indication of the scale is increased, normally in increments equal to the reading-face capacity.

155. Weight, Unit. See unit weight.

156. Zero-Load Balance. A correct weight indication or representation of zero when there is no load on the load-receiving element. (See also zero-load balance for an automatic-indicating scale, zero-load balance for a nonautomatic-indicating scale, zero-load balance for a recording scale.)

157. Zero-Load Balance for an Automatic-Indicating Scale. A condition in which the indicator is at rest at or oscillates through approximately equal arcs on either side of the zero graduation.

158. Zero-Load Balance for a Nonautomatic-Indicating Scale. A condition in which (a) the weighbeam is at rest at or oscillates through approximately equal arcs above and below the center of a trig loop, (b) the weighbeam or lever system is at rest at or oscillates through approximately equal arcs above and below a horizontal position or a position midway between limiting stops, or (c) the indicator of a balance indicator is at rest at or oscillates through approximately equal arcs on either side of the zero graduation.

159. Zero-Load Balance for a Recording Scale. A condition in which the scale will record a representation of zero-load.

160. Zero-Setting Mechanism. Means provided to attain a zero balance indication with no load on the load receiving element. Three types of these mechanisms are:

a. Manual zero-setting mechanism. Nonautomatic means provided to attain a zero balance indication by the direct operation of a control.

b. Semi-automatic zero-setting mechanism. Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator.

c. Automatic zero setting-mechanism. Automatic means provided to maintain zero balance indication without the intervention of an operator.

161. Zone of Uncertainty. The zone between adjacent increments on a digital device in which the value of either of the adjacent increments may be displayed.

3.7 SAFETY CONSIDERATIONS

a. Introduction

NOTE: Because NCWM Publication 12, Examination Procedure Outlines (EPOs) 13 and 13E were copied for the vehicle scale testing section of this handbook, this preamble and the following safety glossary were required to accompany the EPOs. Items in the glossary pertaining to other than grain elevator applications are not included (i.e., testing gasoline provers).

The importance of safety in the weights and measures workplace cannot be overemphasized. During the inspection and testing of weighing and measuring equipment, the issue of safety should be foremost in the inspector's or serviceperson's mind. It is only through conscientious adherence to safety regulations and policies on a regular basis that the inspector or serviceperson can decrease the likelihood of causing serious personal injury, injury to individuals in and around the inspection area, or damage to property and equipment. Safety-consciousness must also extend to the selection and maintenance of testing equipment and other equipment used by an inspector or serviceperson.

Weighing and measuring equipment varies in design and the safety of its use may be affected by other factors in the workplace. Because of this variability, it is impractical to make specific recommendations that will identify or address safety hazards that may be present in a particular jurisdiction. In order to properly address the safety hazards that may be present during an inspection activity, a jurisdiction should consider the following steps in working to minimize the hazards: (1) conduct a job hazard analysis; (2) determine what safety and health training is needed; (3) determine the control (administrative, engineering, and personal protective) needed; and (4) provide a written safety and health program.

Before proceeding with the inspection and testing of a weighing device, the scale inspector should be completely familiar with all safety regulations and policies in effect at the inspection location. Such regulations and policies include state, federal, or local Occupational Safety and Health Administration (OSHA) regulations, safety policies established by the firm in which the inspection is taking place, and safety policies established by the inspector's or serviceperson's employer or any other applicable safety guidelines.

The Examination Procedure Outlines (EPOs) in this publication address a wide variety of activities involving the inspection and testing of various types of weighing equipment. Each of these inspection activities require knowledge of safety information specific to the inspection of that device. Included at the beginning of each section in the vehicle scale test section is a brief paragraph to remind the scale inspector of some of the basic safety precautions which should be taken before proceeding with the inspection procedure. In addition to the basic safety reminder at the beginning of each section, safety reminders are included at various points throughout the body of the section. The safety reminders use "key phrases" to prompt the inspector to remember particular safety precautions. A glossary of these key phrases is included at the back of this publication. The glossary provides a brief explanation of the intent of the safety precaution and in some cases provides a listing of a source or sources where additional information might be obtained pertaining to a particular safety concern.

The safety reminders included in this publication are not intended to include all possible safety precautions which should be taken before proceeding with the inspection of a weighing or measuring device. (Similarly, the safety information and contacts are not a complete listing of all possible sources of information and guidance in the area of safety.) The safety reminders are intended to raise the awareness of the weights and measures inspector or serviceperson and to serve as a reminder to make safety an integral part of all inspection and testing procedures. The National Conference on Weights and Measures hopes that the safety reminders will also encourage the inspector or serviceperson to thoroughly investigate the safety requirements in effect at an inspection site and to identify and practice the safety procedures necessary to prevent personal injury, injury to others, or damage to equipment and property during the inspection.

For additional information on safety in the weights and measures workplace and the development of a safety program, see the July 1991 Final Report of the NCWM Task Force on Safety.

Many policies and regulations will vary from jurisdiction to jurisdiction. It is essential that the inspector or serviceperson be aware of all safety regulations and policies in place at the inspection site and to practice the safety policies established by the inspector's or serviceperson's employer. The safety reminders included in the EPOs contain general guidelines for safety. These guidelines are useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injuries. These guidelines can only be effective in mitigating safety hazards if inspectors and servicepersons receive training in hazard recognition and controls.

b. Glossary of Safety Key Phrases

Chemicals, Petroleum Products, and Hazardous Materials

Be familiar with the nature of the products at an inspection site that is located in a plant or other facility which handles, uses, or packages chemicals, petroleum products, or hazardous materials; it is essential that the inspector or serviceperson be familiar with the nature of the product and any protective measures which should be taken prior to working around the product. For example, some products may cause injury through exposure to the skin or through inhalation of the fumes or airborne particulates. Similarly, caustic products may also damage field standard weights or measures or equipment used in the test process.

Determine whether or not protective clothing or equipment is needed prior to working with the product.

Material Safety Data Sheets (MSDS) can provide much of the basic information about the hazards involved with a product. The manufacturer of the product should be able to provide further information about the product. Several sources of information concerning chemicals, petroleum products, and hazardous materials are listed below.

Glossary

American Chemical Society
1155 16th Street, NW.
Washington, DC 20036
(202) 872-4600

Chemical Manufacturer's Association
2501 M Street, NW.
Washington, DC 20037
(202) 887-1100

American Petroleum Institute
1220 L Street, NW.

Washington, DC 20005
(202) 682-8000

FAX: (202) 682-8036

Look for leakage or spillage of chemicals, petroleum products, or hazardous materials at or near the inspections site. Leakage or spillage of these products can be potentially hazardous if the inspector/serviceperson or facility employee is exposed to the product and is not wearing personal protection equipment. Additionally, any product collecting on the ground surface can result in slippery, unsafe conditions for an individual moving about the inspection area. If leaking or spilled product results in unsafe conditions at the inspection site, it is recommended that the testing procedure be discontinued until the unsafe conditions are corrected.

Clothing

Synthetic clothing should not be worn when working around flammable products. Synthetic clothing melts at high temperatures; if the person wearing the synthetic clothing is exposed to flames, the clothing may melt and stick to the person's skin and result in severe burns.

Combustion can result when an ignition source is present and fuel and oxygen are also available. Many types of synthetic clothing also tend to build up a static charge; this can be dangerous as a potential ignition source around flammable products.

Use caution when wearing loose clothing (or hanging jewelry) around machinery such as conveyor belts, weight movers, meat hooks, gears, etc. The clothing (or jewelry) may become entangled in the machinery and result in personal injury.

Electrical Hazards

Be particularly aware of potential electrical hazards in or near the inspection site when testing electronic devices or working in the vicinity of electrical equipment. Loose or exposed wiring and a frayed or worn electrical cord should be brought to the attention of management at the inspection site. Avoid standing on wet surfaces unless the electrical equipment is properly insulated and grounded.

Emergency Procedures

Always be familiar with emergency procedures BEFORE beginning an inspection. After an emergency has developed, crucial time can be lost if emergency procedures are not known. Be familiar with the procedures to follow in the event of an equipment malfunction or the development of a dangerous situation with the equipment or in the vicinity of the inspection site when operating specialized testing equipment.

Be familiar with the nature of any product being dispensed by a device or being used in or near the inspection area. Know the emergency procedures to be followed when a spill has occurred or a person has been exposed to the product. Knowledge of emergency procedures and related information should include the correct selection and use of fire extinguishers, the location of emergency shut-offs, and evacuation procedures.

Keep a list of emergency phone numbers handy at all times in a notebook or on a card. Examples of numbers to keep are the local fire department, emergency medical facility, and other appropriate public safety agencies.

Eye Protection

Appropriate eye protection is recommended when working around hazardous products which may inadvertently splash into the eyes, and eye-wash facilities should be available. Contact lens wearers should be particularly careful to follow the instructions of their eye-care practitioner and local OSHA representative when working around hazardous products.

Appropriate eye protection should also be worn when working in an area with overhead projections such as meat hooks or other sharp objects or where there is a potential of flying projectiles (e.g., when working near tools that grind, chip, etc.).

Fire Extinguisher

Know the proper use and selection of fire extinguishers for a given application. Contact your local fire department for current information and training.

First Aid Kit

Appropriate first aid kit(s) should be provided for every vehicle and in every laboratory. Consideration should be given to the type of work that the inspector, metrologist, or serviceperson typically performs and the types of hazards typically encountered in these types of activities. Items in addition to those contained in a basic first aid kit may need to be added to address the potential hazards which may be encountered by the person who will be most likely to use the first aid kit. Check with your local OSHA office or with your departmental safety officer for input on the items to be included in each kit.

Lifting

To prevent personal injury, be familiar with and use proper lifting techniques when lifting test weights or heavy equipment. To reduce the probability of back injury, use equipment which would decrease the amount of lifting required whenever possible (e.g., carts for transporting weights, etc).

Periodic training in proper lifting techniques is encouraged.

Location

Carefully examine the inspection site prior to beginning an inspection and testing procedure. Look for potentially dangerous situations such as wet areas which may be slippery (see also **Wet/Slick Conditions**), the use or presence of hazardous and/or flammable materials and any spillage or leakage of these products (see also **Chemicals, Petroleum Products, and Hazardous Materials**), adjacent activities which may contribute to a potential hazard to the inspection, obstructions in the area which may prove to be safety hazards (e.g., objects on the ground which the inspector might trip over), objects in the path of the inspector, exits blocked by test equipment or vehicles, etc. -- see also **Obstructions**), pedestrian or vehicle traffic (see also **Traffic**), steep or narrow stairways, overhead hazards (e.g., feed bins, loading rack equipment, low hanging beams in feed mills and warehouses, overhead activities, low doorways, etc. -- see also **Overhead Hazards**), lack of or defective handrails, and loose or exposed wiring (see also **Electrical Hazards**). Use great care when moving around and working in areas in which these potential hazards are present.

Material Safety Data Sheets (MSDS)

MSDS are provided by the manufacturer of a product to identify the product's basic characteristics and hazardous information. MSDS typically provide information pertaining to the characteristics of a product such as hazardous

ingredients, physical data, fire and explosion hazard information, fire hazard information, reactivity data, spill or leak procedures, special protection information, special precautions, toxicological information, and other relevant information. MSDS can be obtained from the manufacturer of the product. As new information is discovered concerning the properties of a product and the effects of various levels of exposure to it, the MSDS can change. It is recommended that updated versions of the MSDS be obtained on a minimum of an annual basis. For further information on MSDS, contact your local OSHA office.

Obstructions

Care should be taken to avoid injury from obstructions in the work area during the course of an inspection. Obstructions which might prove to be safety hazards include objects on the ground which the inspector might trip over, objects in the path of the inspector to and from the device being tested, steep or narrow stairways, exits blocked by test equipment or vehicles, etc.

Overhead Hazards

Note any overhead hazards such as feed bins, loading rack equipment, low-hanging beams in feed mills and warehouses, activities overhead, and low doorways prior to the inspection. Take precautions (such as wearing a hardhat) to avoid potential injuries as the situation dictates.

Personal Protection Equipment

Included among the many types of personal protection equipment which is available are items such as non-synthetic clothing, coveralls, gloves, barrier cream, non-permeable safety aprons, safety sleeves, safety shoes, respirators, goggles or safety glasses, hearing protection, and hardhats. OSHA and safety-clothing and safety-equipment manufacturers can provide additional information concerning the selection of personal protection equipment for a given type of inspection activity.

Before providing personal protection equipment (PPE), management should determine whether or not PPE is actually required for a particular inspection activity. If it is determined that an employee is exposed to a hazard, the management should first try to minimize the hazard by examining and modifying work methods and conditions. If it is determined that the employee is still exposed

to the hazard after modifying work methods and conditions, consideration should be given to purchasing PPE. It should be realized that certain types of PPE such as respirators can require employee physicals and extensive ongoing training and maintenance; failure to follow these requirements may render the PPE ineffective or even dangerous.

Safety Shoes

It is recommended that safety shoes be worn when performing certain weights and measures activities to prevent personal injury. Safety shoes are available to prevent possible injury to the foot from falling weights or equipment and also to provide protection from slippage and static discharge. Many styles and types of safety shoes are available. The American National Standards Institute and safety-shoe manufacturers can provide additional information concerning the selection of safety shoes for different types of inspection activities.

Safety Cones/Warning Signs

Safety warning signs or safety cones should be positioned to block off the work area when the inspection site is exposed to vehicular or pedestrian traffic. These precautions should also be taken when working around flammable liquids to warn people of a potential hazard; in this instance, it is also recommended that "No Smoking" and "No Open Flame" signs be posted.

Static Discharge

Combustion can result when an ignition source is present and fuel and oxygen are also available. Sources of static discharge introduce the potential of an ignition source into the testing area. Avoid all sources of static discharge when testing or inspecting weighing equipment inside grain facilities.

Scale Support

Before proceeding with a test procedure, be certain that the installation is adequate to support the scale, test weights (equal to the capacity of the scale), and any weight carts, test platforms, platters, chains, hooks, or other accessories used to suspend or support the test weights. Any test platforms, platters, chains, hooks, or other accessories must be capable of supporting the test weights necessary for the inspection.

Traffic

Be aware of vehicular and pedestrian traffic patterns in and around the inspection site. Mark the test spot appropriately by using safety cones, flags, etc.

Transportation of Equipment

Consideration must be given to isolating the inspector/serviceperson from weighing and measuring equipment during the transportation of the equipment to and from the work site. All equipment must be properly secured to avoid exposing the inspector/serviceperson to the potential of flying projectiles.

Wet/Slick Conditions

Caution should be exercised when working in wet, slippery, or icy conditions to avoid slipping or possible injury from electrical sources. Shoes with non-skid soles should be worn to provide adequate traction to prevent slipping.

Absorbent material should be used on any product spills to prevent possible injury due to slipping on a slick surface.